THE IMPACTS OF AGGLOMERATION ECONOMIES AND MARKET ACCESS ON FIRM GROWTH: AN EMPIRICAL ASSESSMENT OF FOOD AND BEVERAGE MANUFACTURING IN NEW YORK STATE

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ABSTRACT

From 1998 through 2007, total manufacturing employment declined 29% in New York State, while food manufacturing employment actually grew slightly (0.96%). Policymakers wishing to retain or develop new manufacturing jobs may find that public support for agribusiness manufacturing is a useful method for creating and retaining manufacturing employment, especially in rural areas. Moreover, the establishment of a healthy food manufacturing sector can be beneficial to local agricultural producers by increasing the local demand for raw agricultural inputs.

To help guide policymakers, agricultural economists have investigated the factors affecting the location decisions and growth of agribusiness manufacturers. To further the understanding of these factors, a comprehensive survey of food and beverage manufacturing establishments in New York State was conducted in 2009. The objectives were to investigate the effect of various aspects of the business environment within the state, identify the effectiveness of various firm-collaborative strategies and public policy interventions on improving firm performance, and collect plant-specific information on current and expected growth across several metrics. The unique plant-level data contains nearly 400 responses, and encompasses a range of firm sizes and industry sectors, allowing for the evaluation of important growth factors differentiated by firm size and sector.

This thesis first provides a detailed analysis of the survey results to identify relationships based on firm size and industry sector. This includes a principal components analysis of business environment factor ratings to identify benefits provided by New York State's business environment, as well as impediments to growth. Then, a growth analysis is presented to estimate the effects of both firm-level and location-specific factors (including labor supply, markets, clustering, and firm

characteristics) on firm-level measures of revenue growth. This work contributes importantly to the literature in the following ways:

(1) The unique dataset used in this analysis provides firm-level measures of growth. While past studies have examined spatial factors affecting new plant location decisions, we are instead able to examine how these spatial factors affect the actual performance of existing plants.

(2) Past studies have attempted to examine the agglomeration benefits derived from firm clustering. This study models upstream, within-stream, and downstream firm clustering simultaneously to compare the relative benefits of each.

(3) To account for the heterogeneous nature of the data that includes representation from both rural and urban processing plants, within-stream firm clustering effects are allowed to vary across urban and rural areas. Previous studies did not account for differences in urban and rural clustering. We propose that differences in firm behavior and market environments between urban and rural firms may create different agglomeration effects.

(4) We test for potential endogeneity of our agglomeration variable and use instrumental variables estimation to correct for potential endogeneity. While Jaenicke et al. (2009) used survey-derived variables to instrument for clustering, we instead use county-level historical data as instruments.

We find evidence of: (1) positive effects from firms locating near upstream and downstream clusters; (2) different effects from within-stream clustering between urban and rural areas; (3) negative effects of within-stream clustering in rural areas; and (4) evidence of little endogeneity problems in model estimation.

BIOGRAPHICAL SKETCH

Jeff Hall was born in Cleveland, Ohio in the winter of 1986. His education eventually brought him to Ithaca, New York to attend Cornell University in 2008, where he studied applied economics. Jeff spends his free time with two Newfoundland dogs, Ozzy and Madison.

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CHAPTER 1

INTRODUCTION

In 2007, there were 1,916 food manufacturing and 202 beverage manufacturing establishments employing at least one worker in New York State (NYS). These establishments employed 54,702 full-time workers (U.S. Census Bureau, 2009a). Food manufacturing has seen steady nominal output growth over the past decade, during a time in which other non-agricultural manufacturing sectors saw a decline in employment. Thus, a viable agribusiness sector is an important source of manufacturing employment in both rural and urban areas, and it also can create mutually beneficial effects with respect to agricultural producers in the state.

Food and beverage manufacturing should be considered an important part of a connected system of agriculture and its related businesses (Figure 1.1). As such, the business environment for food and beverage manufacturers is influenced by the strength of interconnected upstream and downstream industries, agricultural producers and various buyers of food and beverage manufactured goods.

By locating manufacturing plants within NYS, food manufacturing firms receive a benefit from nearness to raw commodity inputs and agricultural producers also receive a benefit from nearness to processors. The food manufacturing industry not only provides jobs and tax income for local communities, but also has been shown to increase incomes for local farms through increases in local commodity demand (Henderson and McNamara, 2000). Policymakers with an interest in creating jobs in rural areas often view agribusiness as a preferred method for rural development because the proximity to agricultural inputs provides rural areas with an advantage over urban areas for these industries (Lambert, McNamara, and Beeler, 2007).

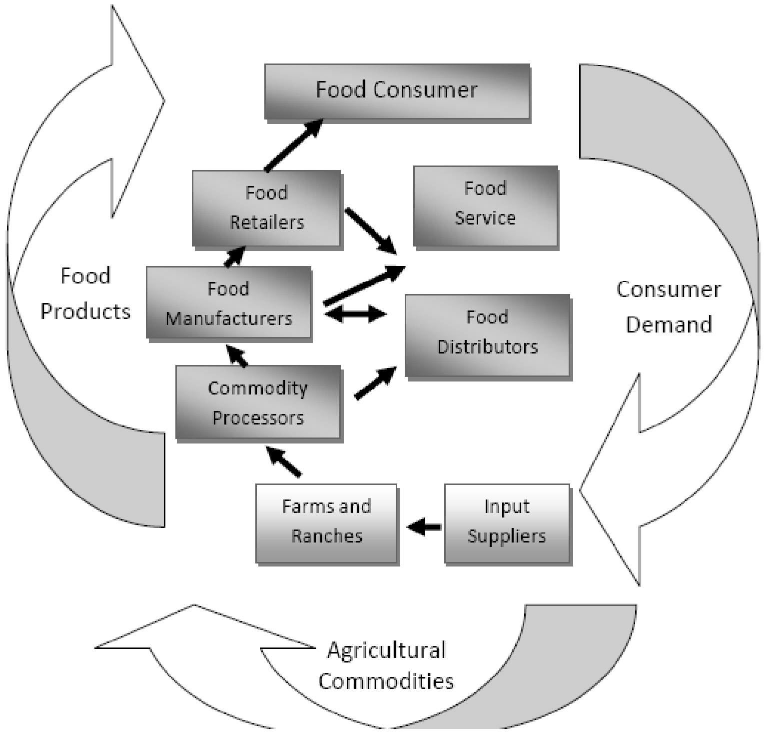

Figure 1.1. The Agriculture and Food System (Adapted from Beierlein et al., 2003)

NYS has the third largest population in the nation (US Census, 2009b) and a sizeable agricultural production economy that provides food and beverage processors a unique location with available access to both agricultural inputs and downstream markets. New York State's farm economy uses 25% of the state's land and generated $4.4 billion in agricultural product sales in 2007 (USDA, 2009). Amongst the largest contributors to New York's agricultural production are livestock, dairy, and fruit and vegetable products. New NYS is the third largest producer of milk, second largest producer of apples, and third largest producer of wine and juice grape in the country (USDA, 2009).

Since 1998, the percent of employment in food manufacturing has decreased at the national level but has remained nearly level in NYS (US Census, 2009a). In 2006, NYS employed 49,397 full time workers in food manufacturing, up from 48,813 in

1998 (Figure 1.2). During the same time period, total employment in beverage manufacturing in the state decreased from 7,054 to 5,895. Comprising only 0.65% of its workforce in 2007, food manufacturers in NYS made up a smaller percentage of workers than at the national level, where food manufacturing accounted for 1.2% of all jobs (Figure 1.3).

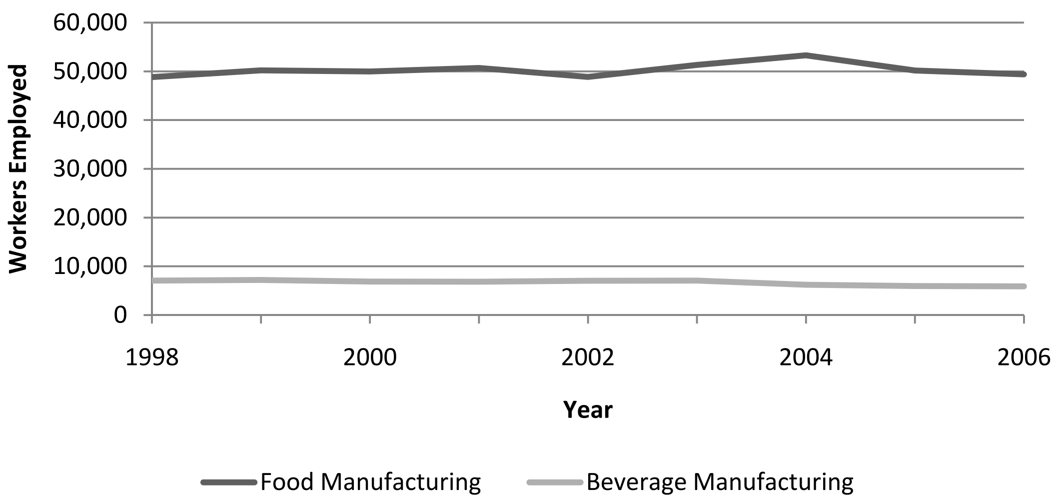

Figure 1.2. New York State Workers Employed in Food Manufacturing and Beverage Manufacturing (U.S. Census Bureau, 2009a)

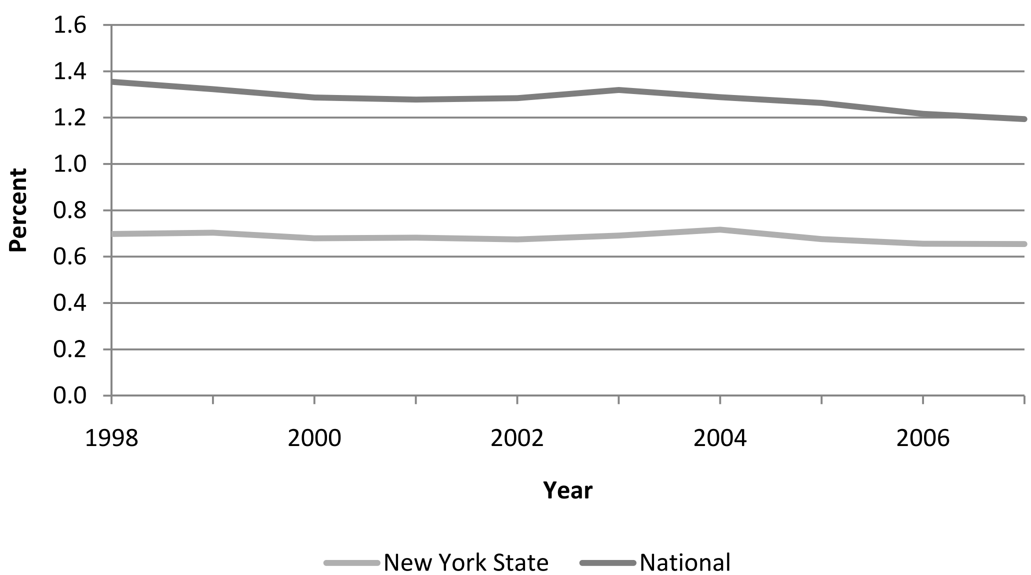

Figure 1.3. Percent of Workers Employed in Food Manufacturing, New York State and U.S. (U.S. Census Bureau, 2009a)

Empirical projections suggest that increased consumer incomes will increase demand for value-added food products, providing a possible source of growth for domestic food and beverage manufacturers (Schmit and Bills, 2007). Changes in the types of products demanded, such as the recent trend in demand for locally produced foods, may provide potential growth for New York State's food and beverage manufacturers.

Compared to other forms of manufacturing, food manufacturing has not experienced as rapid a decline in the domestic workforce at the national level. Figure 1.4 shows the percentage of the workforce in all manufacturing, where NYS experienced the same relative decline in manufacturing jobs as the rest of the country. In 1998, 10.8% of the workforce (752,511 workers) in NYS were employed in manufacturing, but by 2007 this declined to just 7.1% of workers (534,160). Whereas nationally, the manufacturing sector employed 15.7% of the workforce in 1998 and 11.0% in 2007. In this atmosphere, food manufacturing is becoming an increasingly important source of manufacturing employment in both NYS and the nation as a whole.

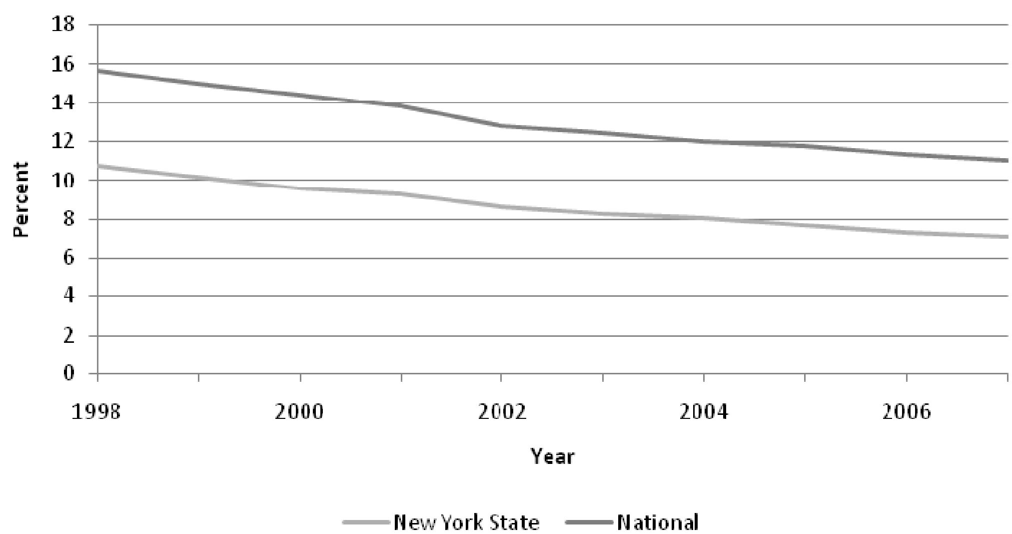

Figure 1.4. Percent of Workers Employed in All Manufacturing, New York State and U.S. (U.S. Census Bureau, 2009a)

Given these recent trends, it is useful to identify the factors affecting the growth of the food and beverage manufacturing industry so that strategies can be formulated at industry and government levels to support the development and expansion of the industry. To this end, a survey of food and beverage manufacturers located in NYS was conducted in early 2009 to identify strategic advantages and barriers to growth for these firms and to develop recommendations for firms and policymakers to improve the competitiveness of the industry.

While the state's substantial agricultural production base and large population may benefit food and beverage manufacturers located in the state, other aspects of the state's business environment may reduce the competitiveness of its industry. Possible barriers to growth within the state include: the lack of government incentives and burdensome regulatory standards, the high costs of capital relative to neighboring states and other regions of the country, high energy costs, labor costs and property and income taxes, and the limited availability of an adequate and qualified labor force (Schmit and Bills, 2007).

In this thesis, a comprehensive evaluation of barriers to growth and improved viability of the NYS food and beverage industry is conducted based on the results of a 2009 plant-level survey. A principal components analysis of a large number of business environment factors is conducted to identify which aspects of the NYS business environment are most beneficial and most harmful to firms, with differences identified based on industry sector, firm size, firm age, and firm location. Further, reported revenue growth rates are investigated based on firm- and county-level factors affecting firm growth (e.g., firm age, labor supply, market access, and firm concentration).

The modeling of firm growth factors furthers the current literature on food manufacturing growth through several aspects. First, to the author's knowledge, no previous study of the food manufacturing industry has examined the effect of growth factors on a measure of growth reported at the firm-level. Past research on food manufacturing industry growth factors has typically used aggregate numbers of establishments to measure growth of the industry. The data used in this analysis provides a unique perspective of the economic conditions associated with the growth of food and beverage manufacturing establishments; through the use of this data, we are able to directly measure the effect of various factors on individual firm performance.

Second, past studies have attempted to examine the agglomeration benefits derived from firm clustering. Empirical research on the effects of agglomeration benefits from firm clustering has typically found positive agglomeration effects accruing to non-food manufacturers, but studies on agglomeration benefits for the food manufacturing sub-industry have found mixed results. This study models upstream, within-stream, and downstream firm clustering simultaneously to compare the relative benefits of each, and to better examine the ways in which food manufacturers may benefit from clustering.

Third, to account for the heterogeneous nature of the data that includes representation from both rural and urban processing plants, within-stream (food and beverage processing) clustering impacts are allowed to vary between urban and rural locations. Previous studies did not account for differences in urban and rural clustering. We expect that differences in firm behavior and market environments between urban and rural firms will create different agglomeration effects.

Fourth, we test for potential endogeneity of our agglomeration variable and use instrumental variables estimation to correct for potential endogeneity. While Jaenicke et al. (2009) used survey-derived variables to instrument for clustering, we instead use county-level historical data as instruments.

CHAPTER 2

LITERATURE REVIEW

A review of related literature on the growth factors for food manufacturers was conducted to guide in the formulation of the empirical model. Most of the literature on food manufacturing industry growth examines the total number of establishments in counties or states over a given period of time. These studies have identified county-level factors that can attract new establishments to the county and have borrowed heavily from similar studies of the county-level factors affecting the location of new manufacturing (food and non-food) establishments. For the most part, studies including all manufacturing establishments have used similar models and have found similar results to the studies which examined only food manufacturers. Thus, evidence from both types of studies will be used to guide the important factors needed in our growth modeling.

Unlike these studies, we wish to examine growth at the firm-level using a self-reported growth measure from a survey of firms. Our review of the literature found no previous studies that have examined the effect of factors on a firm-level measure of growth for food manufacturers. Some studies have investigated the relative importance of various cost factors on food manufacturers (e.g., Vesecky and Lins, 1995; Lopez and Henderson, 1989); while others have examined the aggregate numbers of food manufacturers over time to assess the factors affecting growth of the industry (e.g., Goetz, 1997; Henderson and McNamara, 2000; Davis and Schluter, 2005; Lambert, McNamara, and Beeler, 2007). These studies borrow the framework of others evaluating factors affecting firm growth at the aggregate or total manufacturing industry level (e.g., Rainey and McNamara, 1999; Lambert, McNamara, and Garrett, 2006; Brown, Florax, and McNamara, 2008). Thus, previous literature on the growth of food manufacturing provides little guidance on which firm-level factors are instrumental in explaining firm growth. To obtain some additional background on firm-level factors, literature on the growth of small businesses and the factors affecting the growth of firms was conducted. These studies provide a more generalized framework for the factors affecting firm growth (e.g., Dobbs and Hamilton, 2007; Davidsson et al., 2002; Heshmati, 2001).

The information in this summary of consulted literature will be presented in the following way. First, a general framework for the categories of firm growth factors is described and evidence from studies of small business growth is summarized. Second, evidence from state- and county-level studies of factors affecting the location decisions of manufacturing establishments is presented. This group of studies includes studies of total manufacturing establishments and studies of only food manufacturing establishments, but both categories use similar conceptual frameworks and consider similar county-level determinants. Of particular interest in this study are performance effects which result from firm concentration, or clustering; also known as agglomeration effects. We expand on the theoretical background of agglomeration effects and its relation to firm clustering.

Third, we describe the unique attributes of food manufacturing and how these attributes may cause the results from food manufacturers to differ from studies of all manufacturers looked at in the aggregate. The limited evidence from surveys of food manufacturers will then be presented to further describe the particular characteristics of these types of firms.

One caveat that should be mentioned is that the sample for this study includes both beverage and food manufacturers, which many other studies have not done. We assume that the performance of beverage manufacturers is determined by similar factors determining the performance of food manufacturers. This is a fairly safe assumption as most of the beverage manufacturers in our study appear to operate in a similar manner to other manufacturers; most require agricultural input products like the food manufacturers and use similar distribution and sales channels.

Business Growth

Following Dobbs and Hamilton (2007), the factors determining the growth of businesses can be divided into four general categories: (i) characteristics of the entrepreneur or owner, (ii) management strategy, (iii) firm characteristics, and (iv) industry or business environment factors. Characteristics of the owner can include management skills and entrepreneurial experience. However, since our data do not provide us with any information on the characteristics of the owner/entrepreneur, we will not discuss these factors in depth.

Management strategy factors encompass a range of factors including growth objectives of the firm, employee recruitment and development, product market development, financial management, internationalization, and business collaboration (Dobbs and Hamilton, 2007). For various reasons, some firms may be focused on growth more than others, and firms which have clear growth goals have a better chance of growing (Smallbone, Leigh, and North, 1995). The ability to attract and retain skilled employees is necessary for the growth of a firm. Firm growth has been shown to be dependent on employee skill level (Lin, 1998). Product differentiation has also been shown to increase a firm's market share (Dobbs and Hamilton, 2007).

The financial resources available to a firm often act as a limit to potential growth. External equity financing increases the cash available for firms and thus may increase growth. Evidence has also suggested that firms that export end products may experience higher growth (Zahra, Ireland, and Hitt, 2000), while participation in joint ventures, networks, and alliances provides additional resources to improve the growth potential of small firms (Robson and Bennett, 2000). Due often to data limitations, management strategy factors have not been fully examined for food manufacturers.

Similarly, our data do not contain sufficient information to examine most of these factors, but they have been described to better provide a background of factors affecting firm growth.

Closely related to management strategy factors are the firm-level factors; i.e., characteristics of the firm that management has not set as an operational choice. Two important factors in this category are age and size of the firm. Typically, newly-formed firms will begin at a size which is less than optimal to maximize profits due to limits in financing or the need to establish a market or other similar reasons. Empirical evidence has supported the argument that younger firms tend to grow more rapidly than older firms (Davidsson et al., 2002, Wijewardena and Tibbits, 1999, Heshmati, 2001), and smaller firms have higher and more variable growth rates (Heshmati, 2001; Davidsson et al., 2002), possibly because smaller firms are more dynamic and innovative (Heshmati, 2001). There are a number of other firm-level factors that may affect some categories of firms more than others, such as the legal form of the business. However, studies of manufacturers, and in particular food manufacturers, have provided little evidence of the effects of these types of firm-level factors, again due to the limits of available data.

Spatial Factors Determining Manufacturing Location

Our study will examine primarily a set of factors that describe the business environment and, in particular, focus on county-level growth factors. It is common to use county-level data to proxy for local cost determinant factors, as it is typically the most detailed area at which data are readily available. The operational costs of manufacturing firms, in particular, vary by location because the transport of inputs and outputs between the plant and markets makes up a large share of total costs and the availability of inputs such as labor and raw materials often varies by location. Literature on the location decisions of manufacturing firms has suggested the location decision to be a function of many factors that influence profitability. Brown, Florax, and McNamara (2008) grouped these factors into five categories: (i) market structure, (ii) labor, (iii) infrastructure, (iv) fiscal factors, and (v) agglomeration effects.

Market Characteristics

Market characteristics affecting the profitability of the firm can include market size and density of the market, as well as the distance to markets, for both the inputs and final products markets. Past surveys of manufacturing firms (including non-food manufacturers) have often found that these types of market characteristics are the most important factors affecting the profitability of firms and one of the chief factors determining a firm's location (Blair and Premus, 1987; Calzonetti and Walker, 1991; Crone, 2000). For food manufacturers, input market size and/or density is often proxied for by using a measure of the agricultural output in the local area. For both food and non-food manufacturers, output markets are often proxied for by using measures of population. Some studies have used the distance to US Census metropolitan statistical areas (MSA), and others have included measures of income as proxies for output markets (Table 2.1).

Table 2.1. Comparison of Variables Used in Studies of Manufacturing Establishment Locations

Variable Category	Variables Included	Brown, et al., 2008	Rainey & McNamara 1999	Lambert, et al. 2007	Henderson & McNamara 2000	Asiseh et al. 2009	Davis & Schluter 2005	Lambert, et al. 2006	Goetz 1997
Scope of Study	Geographic Level	county	county	county	county	state	county	county	both
	Manufacturing level	all	all	food	food	food	food	all	food
	Location	US	Indiana	US	Corn Belt	US	US	Indiana	US
Product Market Measures	Population	X	X	X		X	X	X	
	Gross state product per capita	X							
	Distance to nearest MSA		X	X	X				
	Per capita income			X	X	X	X		
	Median income							X	
Input Market Measures	Crop/livestock value			X	X	X	X		X
	Percent of land in agriculture			X					
Labor Supply Measures	Manufacturing wage	X	X	X	X	X		X	X
	Value of production per hour	X							
	Unemployment rate / # unemployed	X		X	X			X	
	Union participation rate	X		X					
	Percent of population with high school diploma			X	X	X		X	X
	Percent of workers in technology or professional							X	
	Percent of workers in handlers, equip. cleaners, helpers, laborers								X
	Percent of workers in machine oper., assemblers, inspectors								X
	Racial diversity measure			X			X		
	Education index		X				X		

Table 2.1. Comparison of Variables Used in Studies of Manufacturing Establishment Locations (continued)

Variable Category	Variables Included	Brown, et al. 2008	Rainey & McNamara 1999	Lambert, et al. 2007	Henderson & McNamara 2000	Asiseh et al. 2009	Davis & Schluter 2005	Lambert, et al. 2006	Goetz 1997
Measures of Infrastructure	Presence of Interstate/Four lane highway		X				X	X	X
	Presence/adjacency to river/great lake			X					
	County road distance or density	X		X	X				
	lLnd availability	X		X					
	Presence of business school or junior college			X					
	Presence of railroad								X
	Presence of port								X
Measures of Agglomeration	Percent of establishments in food manufacturing or manufacturing		X	X					X
	Percent of workforce in manufacturing	X		X			X	X	
	Percent of manufacturing establishments per capita								
	Food manufacturing establishments				X	X			
	Manufacturing establishments						X		
	Economic node				X				
	In or near MSA								
	Business establishments per land area	X							
	Population							X	

Labor

A second category of spatial factors includes labor supply factors, where local wage rates proxy for the cost of labor and local unemployment rates proxy for the labor availability. A large supply of available labor and low costs of labor should increase firm profitability and attract new firms to these locations (Brown, Florax, and McNamara, 2008; Lambert, McNamara, and Beeler, 2007; Lambert, McNamara, and Garrett, 2006).

Amongst studies of only food manufacturing establishments, Goetz (1997) and Henderson and McNamara (2000) found the average county manufacturing wage to have a negative effect on the location of new establishments within the county. Goetz (1997) additionally found county unemployment rates to have a positive effect on the location of new establishments.

Infrastructure

Brown, Florax, and McNamara's (2008) study of manufacturing investment (food and non-food) define infrastructure as including transportation systems and available land. Transportation infrastructure reduces firms' transport costs and provides easier access to markets. Often this is proxied for by the existence of a nearby highway or the density of roadways in the surrounding area. Davis and Schluter (2005) found that the presence of a highway in a county increased the probability of new investments of food manufacturing establishments in the county. Additionally, products can be transported by water or by rail, but studies have failed to find access to these types of transport resources affecting manufacturing plant investment (e.g., Lambert, McNamara, and Beeler, 2007 - county adjacency to a major river or great lake; Goetz, 1997 - presence of a nearby seaport or railroad). The available land in a county may also be considered an infrastructural asset. Brown, Florax, and McNamara (2008) found increased land availability to positively affect the location decision of food and non-food manufacturing establishments.

Fiscal

High taxes are theoretically expected to reduce a firm's profitability. However evidence of tax rates affecting the location decisions of manufacturing plants has been mixed, likely due to the difficulty in determining the true tax burdens of plants within different counties. State and local governments often employ tax rebates and other incentive programs to firms, so the average tax rate within a state or county (often the only publicly available measure) may not accurately describe the true tax burdens for firms (Rainey and McNamara, 1999). Additionally, areas with high taxes are often areas with a large amount of public services, so while a high county tax rate represents increased costs of business for firms through taxes, it may also indicate increased public services or infrastructure that may increase firm profitability.

Clustering and Agglomeration Effects

Of particular interest in studies of manufacturing firm location is the way in which firms at times locate close to one another, called clustering, and the way in which this clustering improves the competitiveness of firms. As can be seen in Table 2.1, studies of county-level manufacturing establishment location factors have used various measures of firm clustering (e.g., number or percent of firms or workforce in manufacturing) as proxies for agglomeration effects, the beneficial effects that clustering can provide to firms. Since clusters are of particular interest in this study, we will provide a detailed explanation of the theory behind clustering and its relationship to agglomeration effects.

Porter (2003) defines a cluster as "a geographically proximate group of interconnected companies, suppliers, service providers, and associated institutions in a particular field, linked by externalities of various types". The concentration of these firms in a geographic location provides competitive advantages for the firms, which occur from the spillover of factors such as technology, labor, knowledge, and regional agglomeration effects (Shields, Barkley, and Emery, 2008). The actual mechanism by which clusters lead to increased competitiveness for firms varies, and empirical evidence for the development of clusters is heavily based on case-studies (Woodward and Guimaraes, 2008). Examples include information technology clusters, suppliers surrounding automotive plants, and firms locating around public activities such as government offices or universities (Shields, Barkley, and Emery, 2008).

Traditional economic development based on neoclassical location theory would suggest that a state government should act to reduce state-level costs of doing business in order to attract new investments. Economic development based on Porter's (2003) notion of a cluster would imply that the state government should instead identify local clusters within the state where a local comparative advantage exists and then create policies which benefit these clusters specifically. For example, suppose a state government had a set number of dollars budgeted for economic development within the state. The neoclassical approach to economic development would suggest that these dollars should be spread throughout the state using tax cuts or infrastructure improvement to attract firm investment. Targeted economic development through clustering, however, would suggest that the state should identify ways in which it already has a comparative advantage over other states and then use the economic development funds to target industries which benefit from that comparative advantage.

For example, if a city has a ready supply of experienced industrial skilled labor, then the state could use funds to attract manufacturing establishments to the city. If a state has unique transportation infrastructure such as a seaport or highway access to large population centers, then the state could use funds to attract firms which would particularly benefit from access to these transportation resources. If a state had a university that was developing new technologies, the state could use funds to support technology start-up firms. If states (or other public entities) are able to correctly identify an existing comparative advantage and further strengthen it through the use of targeted economic development funding, the return on investment could be higher than through general neoclassical development methods.

However, Porter's (2003) concept of clusters lacks a theoretical foundation to identify the actual mechanism in which collocation of firms creates comparative advantages (Woodward and Guimaraes, 2008). As a result, studies have identified examples of where clustering has produced beneficial effects for the included firms and identified the mechanisms through which the clustering created the benefits (e.g., knowledge spillovers, shared suppliers, etc.), however it remains somewhat ambiguous as to what *a priori* conditions must exist in order to create beneficial effects from clustering.

From studying the instances of naturally occurring firm clusters (without government intervention), the reasons for clustering can be separated into two primary categories (Deller, 2008). First, according to neoclassical firm location theory, firms locate in a location which minimizes costs based on spatial factors such as access to markets, labor supply, etc., so a least-cost location may attract many firms to collocate. One example of this would be the cluster of suppliers surrounding an auto plant. For each firm individually, the profit maximizing location is a location close to the auto plant where there is easy access to the output market (the plant); as a result, the suppliers locate close together. Note that in this case each supplier does not necessarily benefit from being close to other suppliers. In the second category, agglomeration economies can provide external economies of scale to firms which collocate. An example of this would be a technology cluster where the movement of skilled employees and new ideas between firms benefits all the firms in the cluster. In this instance, each firm benefits directly from being close to similar firms.

Empirical studies of spatial factors on firm performance attempt to include measures of the factors causing the first category of firm clusters. By controlling for spatial factors such as markets, infrastructure, and labor supply, the remaining benefits from clustering would theoretically be caused by the second category, agglomeration economies.

Agglomeration Economies

We define agglomeration economies as instances in which the clustering of firms creates benefits to the firms either through stimulating consumption or reducing production costs (Selting, Allanach, and Loveridge, 1994). Agglomeration economies produce external economies of scale. Economies of scale are instances when a firm's per-unit costs decrease as the quantity of goods produced increases. A standard example of economies of scale would be an automobile producer who faces a large fixed cost to design an automobile. As this manufacturer produces more output, the fixed cost can be divided amongst a larger quantity of goods and the per-unit cost decreases. This is an example of an internal economy of scale because per-unit costs decrease as the firms output increases. Through agglomeration economies, firms experience external economies of scale where an individual firm's per unit profits increase as the total production of the cluster increases, even if the individual firm's production does not increase. There are two primary types of agglomeration effects: localization economies in which firms benefit from locating near other firms and urbanization economies in which firms benefit from the dense population of urban areas (Lambert, McNamara, and Garrett, 2006).

One could imagine a situation in which a manufacturing establishment locates near other manufacturing establishments so that it could easily access a labor supply with experience in manufacturing or have nearby service providers such as machine repair firms. In New York State's food manufacturing industries, similar firms will often work together for mutually beneficial reasons. For example, a group of bakeries in a city can negotiate lower prices from suppliers if they purchase input products as a group. Wineries located close together in the Finger Lakes region are able to promote the group of wineries as a whole, thereby attracting more tourist business than if each winery promoted itself independently. These are all examples of agglomeration effects as in these situations each firm is more profitable when locating closely together than if they were located further apart.

Unique Attributes of Food Manufacturers

The studies of factors influencing the location of food and non-food manufacturing establishments thus far (i.e., the studies in Table 2.1) have used the same theoretical basis to explain manufacturer location decisions. Studies of food-manufacturer location decisions typically use the same spatial determinants that non-food manufacturers use with the addition of some measure of local agricultural production. Goetz (1997) states that there is no obvious *a priori* reason why the growth factors of food manufacturing should differ from non-food manufacturing, but the relative importance of factors may differ. Goetz gives the examples of high transportation costs of bulky agricultural commodities and products which are perishable. For these types of reasons food manufacturers may be particularly concerned with their location with respect to input and output markets.

Particular interest has been paid to how food manufacturers may need to locate based on access to markets because of the nature of the inputs or products. Food manufacturers are sometimes categorized into three categories depending on the relative costs experienced by the firm: supply-oriented, demand-oriented, and footloose (Henderson and McNamara, 2000; Asiseh et al, 2009). For supply-oriented firms, procurement costs are the primary costs faced by the firm, so they locate in regions which provide easy access to agricultural inputs. For demand-oriented firms, distribution costs are the dominant costs faced by the firm so these firms locate near output markets. For footloose manufacturers, neither procurement nor distribution costs are dominant. These manufacturers often produce a variety of products instead of just one specialty. The location decision of footloose manufacturers is thus dependent on a range of cost factors such as labor, infrastructure, etc., in addition to market location. Henderson and McNamara (2000) divided the food manufacturing sub-industries into these three categories as shown in Table 2.2.

Table 2.2. Examples of Food Manufacturing Firms by Category

Supply-Oriented Firms	Demand-Oriented Firms	Footloose Firms
Soybean Oil	Soft Drink Bottling	Canned Specialties
Meat Packing	Fluid Milk	Frozen Specialties
Cheese	Animal Feeds	Breakfast Cereals
Butter	Bread and Rolls	Flour Mixes and Doughs
Cottonseed Oil	Ice Cream	Pet Foods
Cane Sugar	Manufactured Ice	Cookies and Crackers
Flour Milling	Pasta	Frozen Baked Goods
Rice Milling	Cooking Oil/Margarine	Sugar Confectionary
Meat Processing	Potato Chips and Snacks	Chocolate Confectionary
Frozen Seafood	Pickles and Sauces	Nuts and Seeds
Poultry	Beer	Wines and Brandy
Beet Sugar		Distilled Spirits
Coffee		Flavorings
Rendering		Miscellaneous Foods
Canned Seafood		
Processed Milk		
Wet Corn Milling		
Canned Fruits and Vegetables		
Dried Fruits and Vegetables		
Frozen Fruits and Vegetables		
Other Vegetable Oils		
Malt		

Source: Henderson and McNamara (2000)

We would expect that studies of firm location factors would find the same factors to influence food manufacturers as non-food manufacturers, but, for food manufacturers, the market location factors may be dominant. Depending on whether the study's sample was heavily weighted towards supply-oriented, demand-oriented, or footloose sub-industries, the prevailing factors may be different. Generally, this characterizes the conclusions of studies of food-manufacturer location factors, which will subsequently be summarized.

Evidence from Food Manufacturers

Goetz (1997) examined the factors which affect food manufacturing industry growth by examining the change in numbers of establishments at the county- and state-level over the continental US between 1987 and 1993. This study found states that had lower labor costs, higher education, high unemployment, and larger populations experienced higher rates of growth. At the county-level, labor supplies with more education, higher unemployment rates, and a lower manufacturing wage rate led to more growth in the number of establishments. Additionally, counties with a larger population attracted more establishments and food manufacturing firm concentration appeared to have a negative effect on the establishment of new firms in the county. When the model was estimated separately for each of the sub-industries at the county-level much variation was found between sub-industries. This may be due to the differing cost structures of the sub-industries within food manufacturing as is described by the supply-oriented, demand-oriented, footloose categorizations.

Henderson and McNamara (2000) used a similar approach to examine the factors affecting the county-level number of new investments in large food manufacturing establishments in Corn Belt counties between 1987 and 1995. Their study considered all large food manufacturing establishment investments, as well as investments separated into supply-oriented, demand-oriented, and footloose firm categories. They found that large food manufacturing plant investment was associated with counties that provided access to agricultural markets, access to product markets, low labor wage rates, and access to transportation infrastructure. Unlike Goetz (1997), this study found evidence that agglomeration economies from firm concentration were associated with increased new firm investments.

Henderson and McNamara's (2000) separate estimates for supply-oriented, demand-oriented, and footloose large food manufacturers found that the relative importance of factors varied between the three categories of manufacturers. Supply-oriented firm investments were associated with counties with large agricultural production and also with counties providing agglomeration benefits, counties with transportation access, and counties with favorable labor conditions. Demand-oriented firm investments were associated with counties with access to product markets and also in counties with transportation access. Demand-oriented firms appeared not to benefit from locating near other food manufacturers. Investment in new footloose firms was associated with counties which provided access to product markets and with more urban areas.

Lambert, McNamara, and Beeler (2007) examined factors affecting the increase in county-level number of food manufacturing establishments from 2000 to 2004 over the continental US. New plant investment was found to be influenced by county population, labor quality, and transportation infrastructure. Supply-oriented, demand-oriented, and footloose firms all appeared to select plant locations near urban areas or in rural areas that provided access to product or input markets. Agglomeration economies through firm clustering were also found to increase new investments.

Asiseh et al (2009) used a similar framework to analyze the state-level factors influencing the change in number of food manufacturing establishments in the US from 1997 to 2002. Effects were estimated separately for small and medium-large establishments as well as for all establishments. Factors describing states that experienced increases in medium-large establishments were nearly the same as factors describing states with increases in small establishments. States with increased populations and increased agricultural production over the time period tended to have increased numbers of food manufacturing establishments.

Davis and Schluter (2005) examined the number of new food manufacturing plants at the county-level between 1991 and 1997 for the US, and focused specifically on more detailed labor force descriptions. Labor force heterogeneity at the county-level was proxied for using a measure of the diversity in education levels, a measure of the diversity of occupations, and income inequality. A labor force with diverse education and experience was found to attract new plant entry. The authors suggest that much of the evidence showing food manufacturing plants locating near urban areas may be explained by the heterogeneous labor force within these urban areas.

Jaenicke et al (2009) used a survey of organic handlers to investigate both firm- and county-level factors influencing the total annual gross sales per firm. In particular, the effect of being located in a cluster was investigated at different defined levels of clusters. The authors conclude that there is evidence of clusters providing beneficial effects to firms' efficiency, although the quantity of that benefit is highly dependent on the way in which the cluster is defined.

Several studies have attempted to identify the factors influencing operations of food processors through direct surveys asking firms to identify and rank factors. Vesecky and Lins (1995) surveyed agribusiness firms in Illinois and asked them whether they were expanding or contracting and then to score a variety of business environment factors on how important the factor was to their decision to expand or contract. Expanding firms ranked the plant's proximity to markets as the most important factor in their decision to expand. Also important were the proximity to distribution centers and availability of transportation. The factor most influencing firms' decisions to contract was the availability (or lack thereof) of transportation.

Lopez and Henderson (1989) conducted a survey of food processors in New Jersey which asked respondents to rate the relative importance of a variety of factors on the location decision of the firm. The results indicated that location decisions were influenced most heavily by factors related to markets; specifically the availability of raw products, proximity to the market, and proximity to distribution centers.

Based on the review of literature, we expect the growth of food and beverage manufacturers in our sample will be heavily dependent on market access factors and possibly on agglomeration effects. The studies reviewed consistently found market access variables to be influential on food manufacturers, but evidence on agglomeration benefits have been mixed. Since studies considering all manufacturers have found evidence of agglomeration benefits from densely located firms (Brown, Florax, and McNamara, 2008; Gibbs and Bernat, 2001), studies that considered only food manufacturers expected to find similar benefits accruing to densely located firms, yet results suggest there may be some differences. Goetz (1997) and Asiseh et al (2009) found positive agglomeration benefits at the state-level, but Goetz (1997) found negative effects from agglomeration at the county-level. When Henderson and McNamara (2000) narrowed their sample to only large food manufacturers they found positive county-level agglomeration benefits. Lambert, McNamara, and Beeler (2007) found positive county-level agglomeration benefits accruing to all three categories of food manufacturers (supply-oriented, demand-oriented, and footloose) in 'micropolitan' and 'rural' areas.

Previous studies of agglomeration effects from the clustering of food manufacturers have primarily examined the clustering of food manufacturers, with limited attention to upstream and downstream cluster effects. Yet, past studies of clustering have shown that upstream and downstream clustering can provide agglomeration benefits. As such, we will directly examine possible agglomeration benefits from upstream, downstream, and within-stream clusters. Additionally, our data provide us with a firm-level reported measure of revenue growth. Previous studies of food manufacturers have not had access to a firm-level growth measure, so this study has the potential to examine how factors affect the firm itself, rather than more aggregate measures of the size and performance of the industry.

CHAPTER 3

PLANT SURVEY DATA

To collect current information on food and beverage manufacturing operations in New York State (NYS), a plant-level survey was developed. The survey gathered information on primary industry sector identification, plant size (revenues, employees), sales channel distribution, input procurement areas, the effect of various business environment factors on firm operations, the use and importance of firm collaborative strategies, and past, current, and future growth projections regarding revenue, employee staffing, and capital investments. The survey was pre-tested with a small group of manufacturers representing various sectors and agricultural development agencies regarding the clarity of questions and level of useful information. A copy of the final survey is included in Appendix A. An online version of the survey was also made available using Checkbox 4.6 and firms could choose either the paper or online survey to complete and return.

A database of 4,302 current food and beverage manufacturing establishments was developed using several sources of information including purchased databases from Manufacturers News[1] and Harris Interactive[2], and publicly-available datasets from the USDA Meat and Poultry Inspection Database, NYS Cattle Health Assurance Program[3], NYS Department of Agriculture and Markets Food Safety Inspection Service, NYS MarketMaker[4], NYS Wine and Grape Foundation[5], and the NYS Maple Producers Association[6]. In February 2009, the mail survey was administered along

[1] Manufacturers News Inc., Evanston, IL (http://www.manufacturersnews.com)
[2] Harris Interactive, Inc, New York, NY (http://www.harrisinteractive.com)
[3] New York State Cattle Health Assurance Program, New York State Department of Agriculture and Markets (http://nyschap.vet.cornell.edu)
[4] New York State MarketMaker, Cornell Cooperative Extension-NYC (http://ny.marketmaker.uiuc.edu)
[5] New York Wine and Grape Foundation, Canandaigua, NY (http://www.newyorkwines.org)
[6] New York State Maple Producers Association, Syracuse, NY (http://www.nysmaple.com)

with a cover letter explaining the research project (see Appendix B). A reminder mailing was sent one month later to firms who had not responded (see Appendix C). Finally, follow up phone calls and emails were delivered to a select number of plants to improve the overall response rate.

After deleting firms who were no longer in operation, as well as those returned as “undeliverable”, the net count of surveyed plants was 3,684. A total of 482 (13%) useable surveys were ultimately returned. Figures 3.1 and 3.2 show the locations of the original mailing list plants and locations of the responding plants. While the response rate was relatively low, a wide distribution of surveys by firm size, location, and industry sector was received.

Due to data limitations it was not possible to assign a NAICS code to each plant on the initial (4,302 plants) or revised (3,684 plants) plant enumerations. However, a pseudo-response rate by industry can be estimated by totaling establishment numbers from U.S. Census records for 2006 (most recent available) for employer and non-employer establishments (U.S. Census Bureau, 2009a; U.S. Census Bureau, 2009c) and comparing to establishment counts in the survey. The lowest response rates were from bakery and tortilla (2.9%), other food (6.5%), maple (6.3%), and sugar and confectionary (7.4%) operations. The highest response rates were from beverage (28.5%), meat (23.9%), and dairy (21.0%) plants.

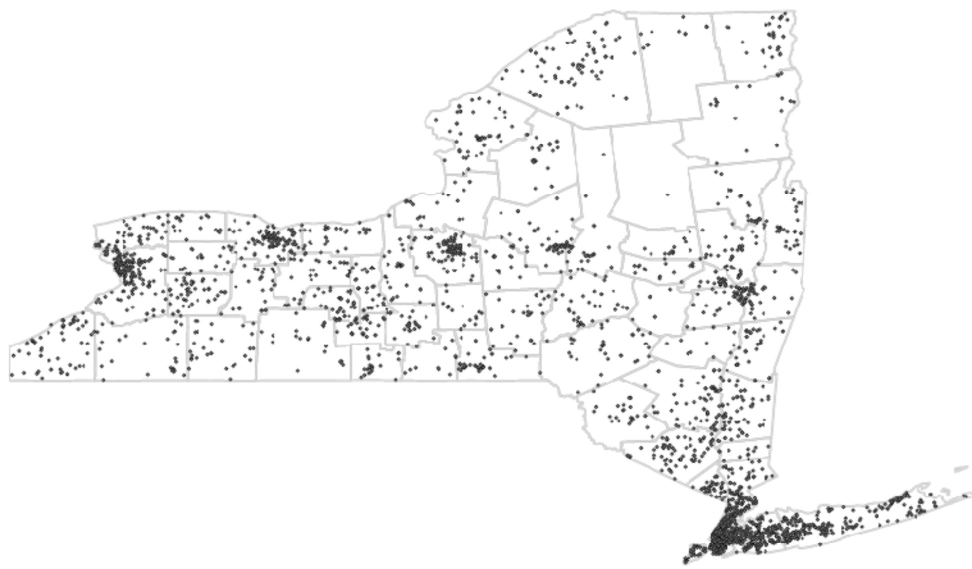

Figure 3.1. Plant Locations of Surveyed Firms (N=3,684)
Source: 2009 NYS Food and Beverage Manufacturing Survey

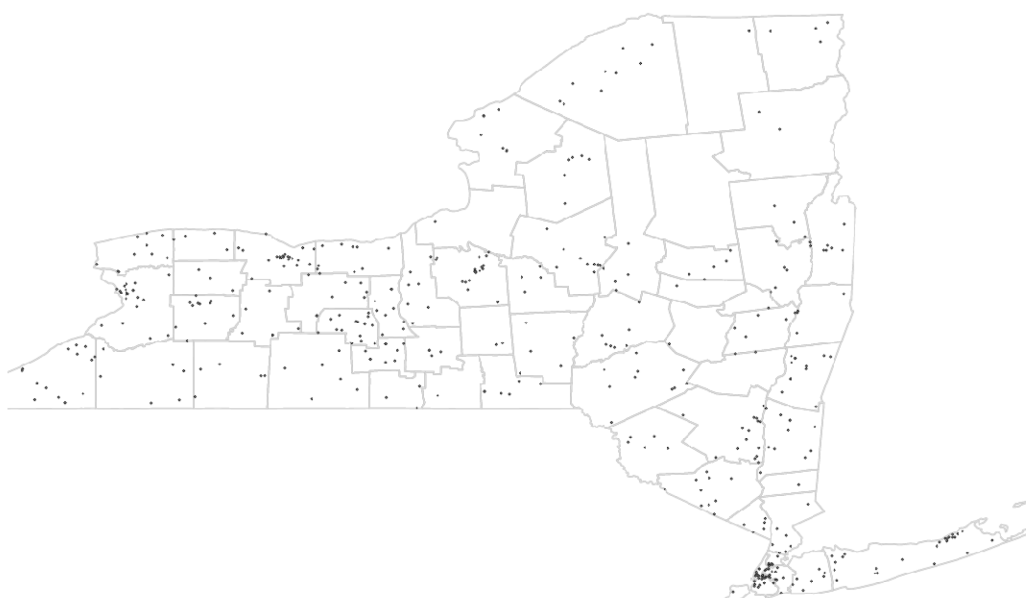

Figure 3.2. Plant Locations of Firms with Useable Surveys Returned (N=470)
Source: 2009 NYS Food and Beverage Manufacturing Survey

Plant Demographics

Many of the responses were from small firms. For example, 17.7% of firms had no full or part-time employees, and 61.8% of firms had fewer than ten employees (Figure 3.3).[7] The employee size of responding firms is compared with the corresponding NYS totals from the 2006 County Business Patterns (U.S. Census Bureau, 2009a) in Figure 3.4[8]. The distribution of firms by employee size appears to be reasonably representative of state-wide Census estimates. The prevalence of smaller firms is also evident when comparing annual average revenues, where 63.5% of respondent plants had annual revenues of less than $1 million (Figure 3.5).

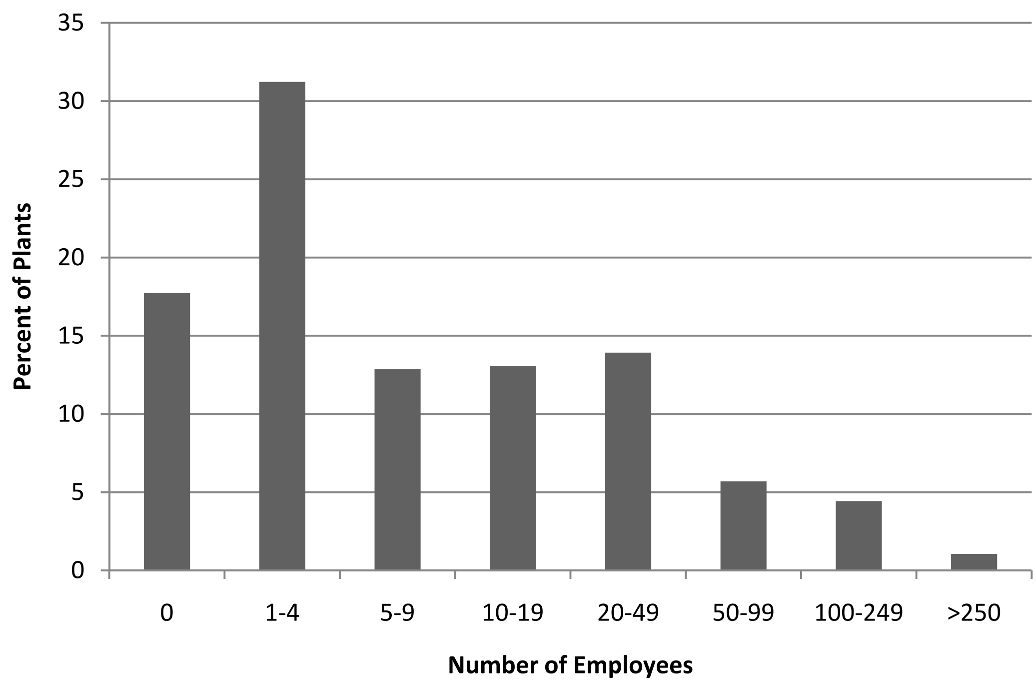

Figure 3:3. Distribution of Plants by Number of Employees (N=474)
Source: 2009 NYS Food and Beverage Manufacturing Survey

[7] The number of plants answering each question (N) is shown in each of the corresponding figures.
[8] Maple producers and non-employee firms are excluded as these firms are not included in U.S. Census County Business Pattern data.

The high proportion of smaller firms in the sample is explained further if responses are looked at by industry sector (Figure 3.6). Alcoholic beverage manufacturers (17.6%) and maple processors (17.2%) were the largest responding groups, followed by bakery and tortilla manufacturers (12.7%) and meat processors (12.2%). Maple producers had an average of 1.4 employees, the smallest average of the industry categories (Figure 3.7).[9] Dairy processors showed the highest employment per establishment with an average of 65.0 employees. Non-alcoholic beverage manufacturers (e.g., carbonated soft drinks, bottled water) and sugar/confectionary operations were a distant second with about 42 employees.

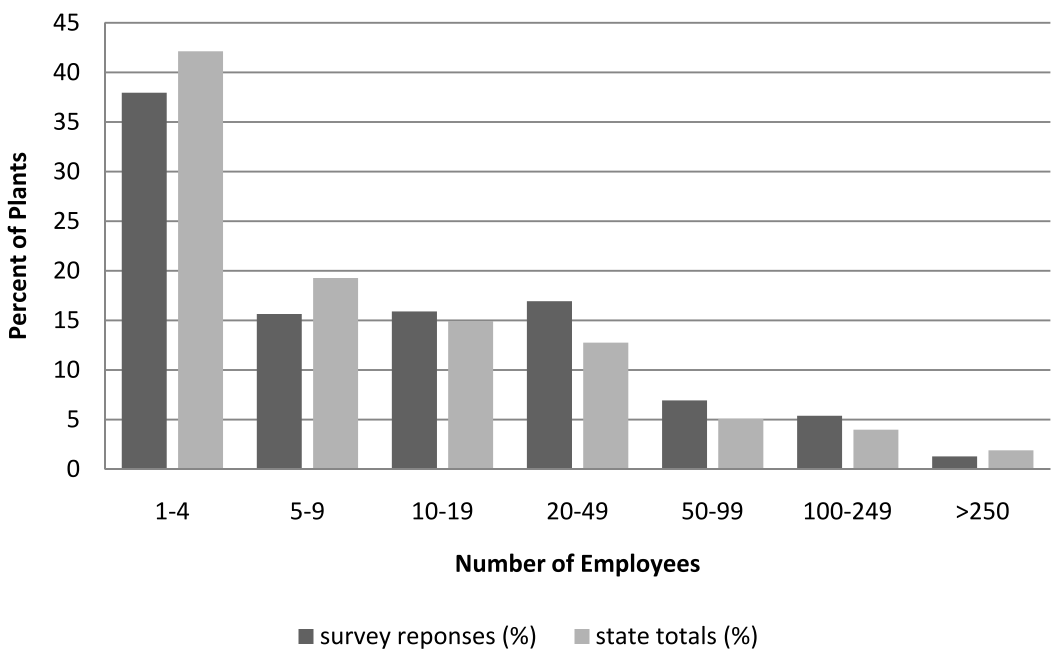

Figure 3.4. Distribution of Plants by Number of Employees
Source: 2009 NYS Food and Beverage Manufacturing Survey, U.S. Census Bureau (2009a)

[9] Number of employees was reported using categories. Average values were calculated using the midpoints of these categories.

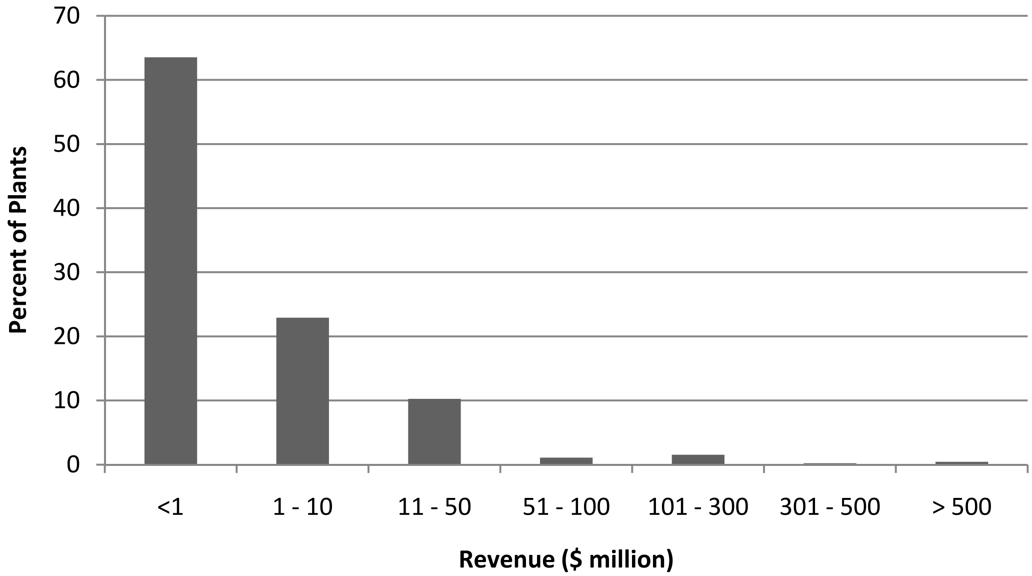

Figure 3.5. Distribution of Plants by Revenue Category (N=458)
Source: 2009 NYS Food and Beverage Manufacturing Survey

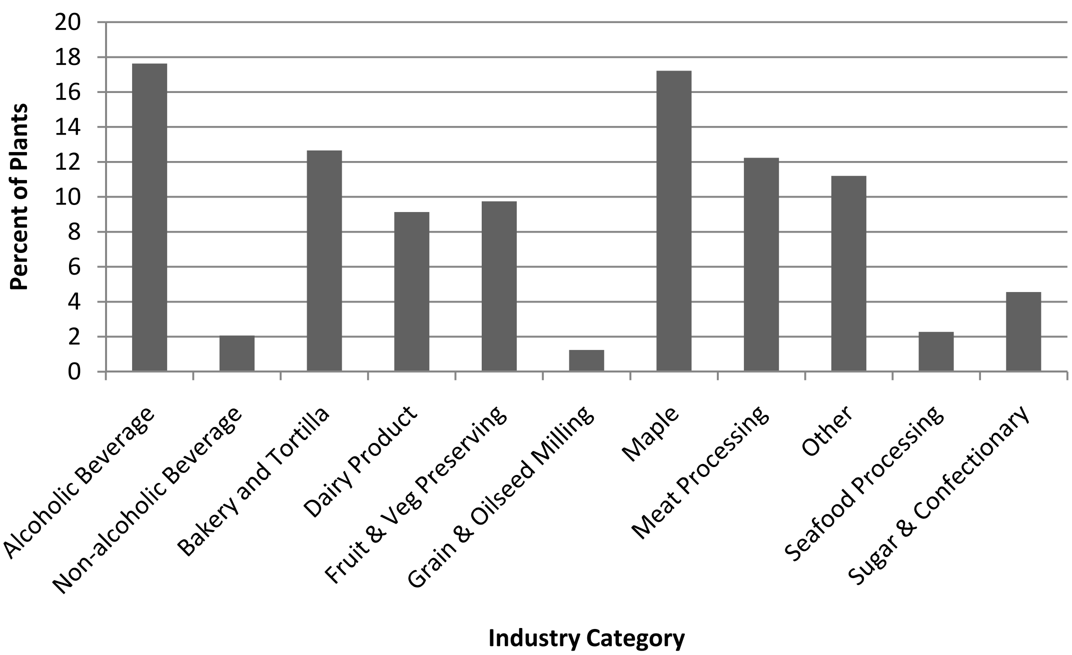

Figure 3.6. Distribution of Plants by Industry Category (N=482)
Source: 2009 NYS Food and Beverage Manufacturing Survey

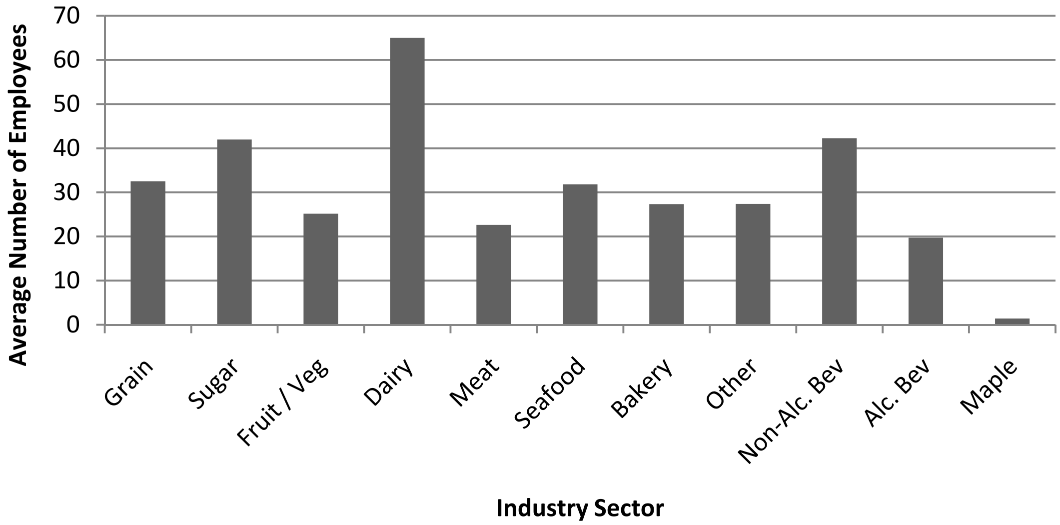

Figure 3.7. Mean Number of Employees by Industry Category (N=482)
Source: 2009 NYS Food and Beverage Manufacturing Survey. The number of employees was reported in a categorical format. Mean employees were calculated using midpoint values of the categories.

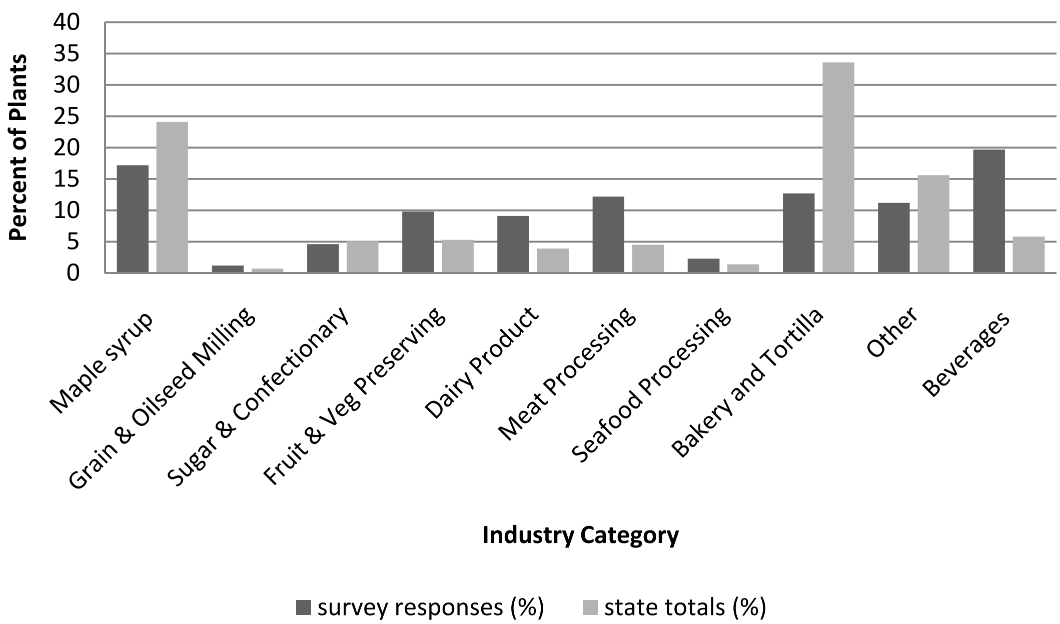

Figure 3.8. Distribution of Plants by Industry Sector, Comparison of Survey and State Totals
Source: 2009 NYS Food and Beverage Manufacturing Survey; U.S. Census Bureau (2009a), USDA (2009)

Relative to state-wide industry numbers, the survey responses seem to under represent bakeries and tortilla manufacturers and, to a lesser extent, maple producers and other food manufacturers (Figure 3.8). The survey sample has a much higher proportion of beverage manufacturers (including both alcoholic and non-alcoholic processors) than state-wide estimates, and also appears to slightly over represent fruit and vegetable processors, dairy processors, and meat processors.

On average, responding plants have been in business for 30 years (Figure 3.9). Grain and oilseed milling plants (N=6) have been in operation an average of 85 years, the longest of all industry categories. The youngest plants were in the alcoholic beverage category, with an average age of 15.5 years. The younger age of alcoholic beverage manufacturers likely reflects the strong growth in new establishments in the wine industry over the last several years.

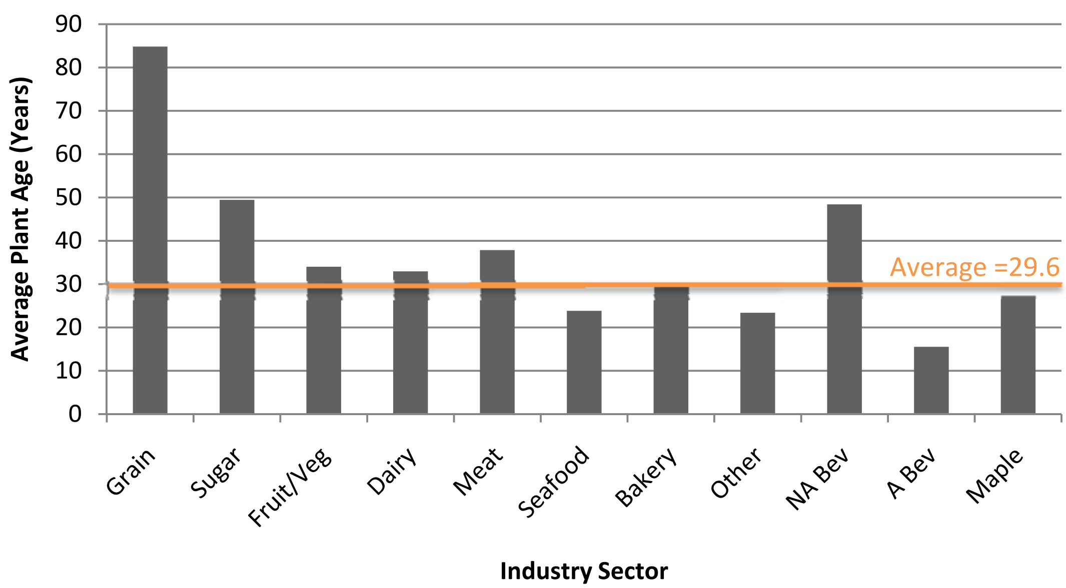

Figure 3.9. Distribution of Plants by Industry Category (N=470)
Source: 2009 NYS Food and Beverage Manufacturing Survey

The majority of responding plants belonged to single-plant firms; only 11% belonged to firms with additional plants, either in NYS or elsewhere. Approximately 95% of responding plants were headquartered in NYS, with the majority (79%) located in upstate New York.[10] Of the plants located in upstate New York, 41% were either maple or alcoholic beverage processors. The largest industry categories of downstate plants were bakeries and other food processors, making up 56% of downstate respondents.

Establishments were also asked about the production of organic products, where approximately 21% of respondents produced organic products as part or all of their processing activity. Of these firms, 50% viewed customer demand for their organic products as increasing, 36% believed customer demand as staying the same, and 14% expected decreasing consumer demand for their organic products.

Input Procurement and Sales Distributions

Manufacturing plants were asked to provide information on the distribution of product sales to various types of buyers (e.g., wholesalers, retailers, consumers, etc.). Across all plants, nearly 40% of sales were direct to consumers, and strongly influenced by the high proportion of maple processors and wineries in the sample. Sales to wholesalers and retailers followed, at around 23% and 21%, respectively (Figure 3.10). Smaller firms sold relatively more direct to consumers. Specifically, firms with less than 10 employees sold an average of 50% of their sales directly to consumers.

[10] Downstate New York was defined as Rockland, Putnam, and Westchester Counties, the New York City Burroughs, and Long Island. All other locations in the state were defined as upstate New York.

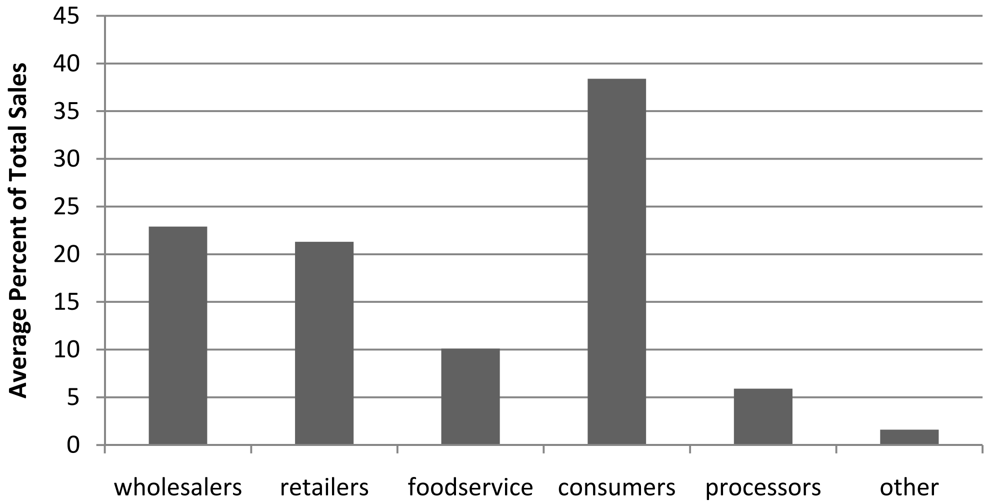

Figure 3.10. Average Sales Distribution by Market Channel (N=468)
Source: 2009 NYS Food and Beverage Manufacturing Survey

As expected, direct-to-consumer sales made up a large percentage of sales for maple producers and alcoholic beverage producers, while non-alcoholic beverage producers and dairy manufacturers sold primarily to retailers and wholesalers (Figure 3.11). Overall, only a small percentage of the respondents' sales went to the foodservice industry or to additional processors (Figures 3.10 and 3.11).

In addition to differentiation by customer type, firms were asked to estimate the proportion of raw product input costs and product sales by geographic location. Interestingly, the majority of sales seemed to be near the location of the producer (Figure 3.12). Specifically, 71% of total sales for upstate plants went to upstate New York locations. Likewise, downstate respondents sold, on average, 67% of total sales in the downstate area and 24% of total sales to other states in the US. However, given their location, it is likely that much of these sales out-of-state are to the states surrounding the downstate region such as New Jersey and Pennsylvania. Few firms were exporters as only 1.5% of upstate firms' sales and 2.8% of downstate firms' sales went to foreign countries.

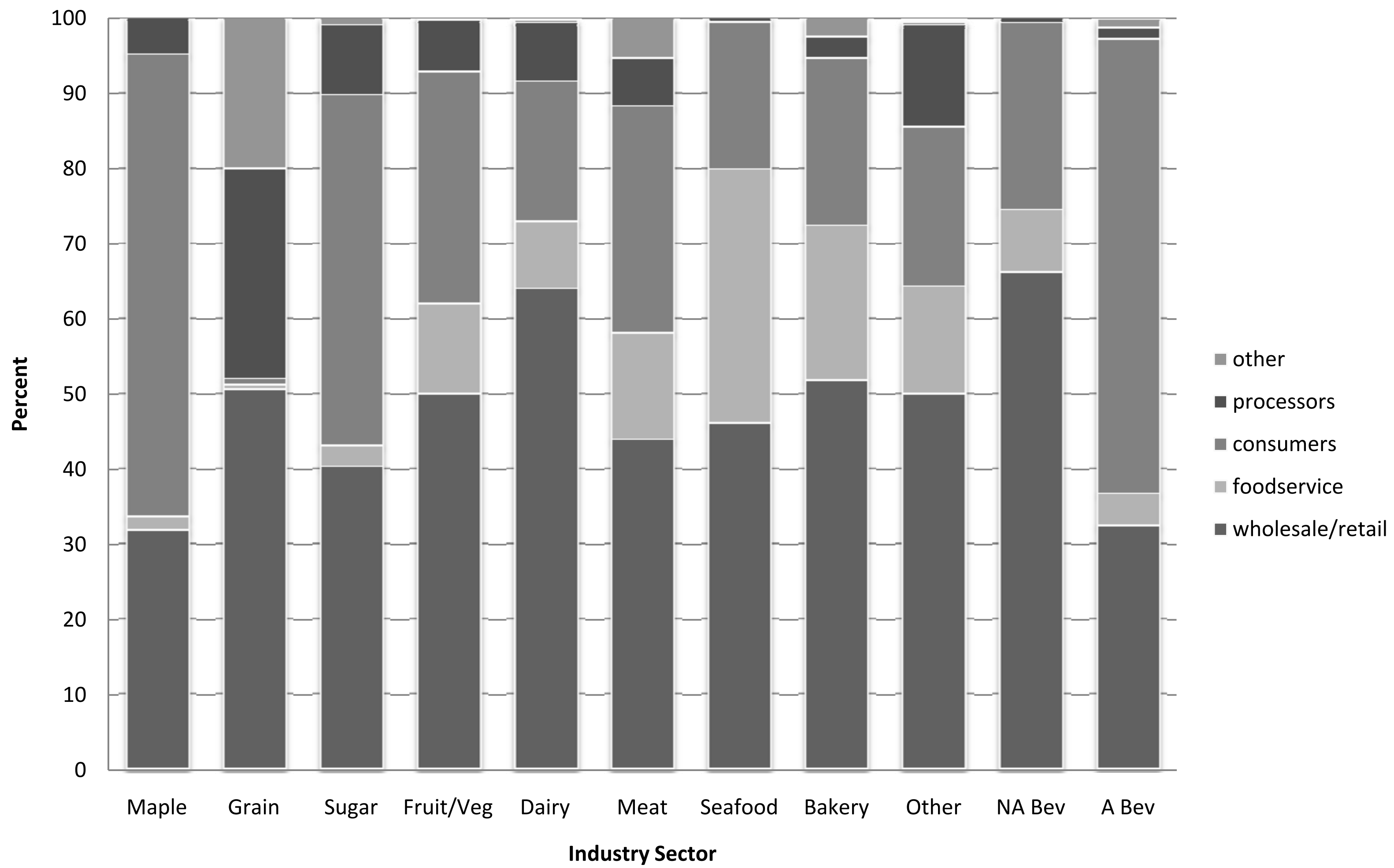

Figure 3.11. Distribution of Plant Sales by Market Channel and Industry Sector (N=468)
Source: 2009 NYS Food and Beverage Manufacturing Survey

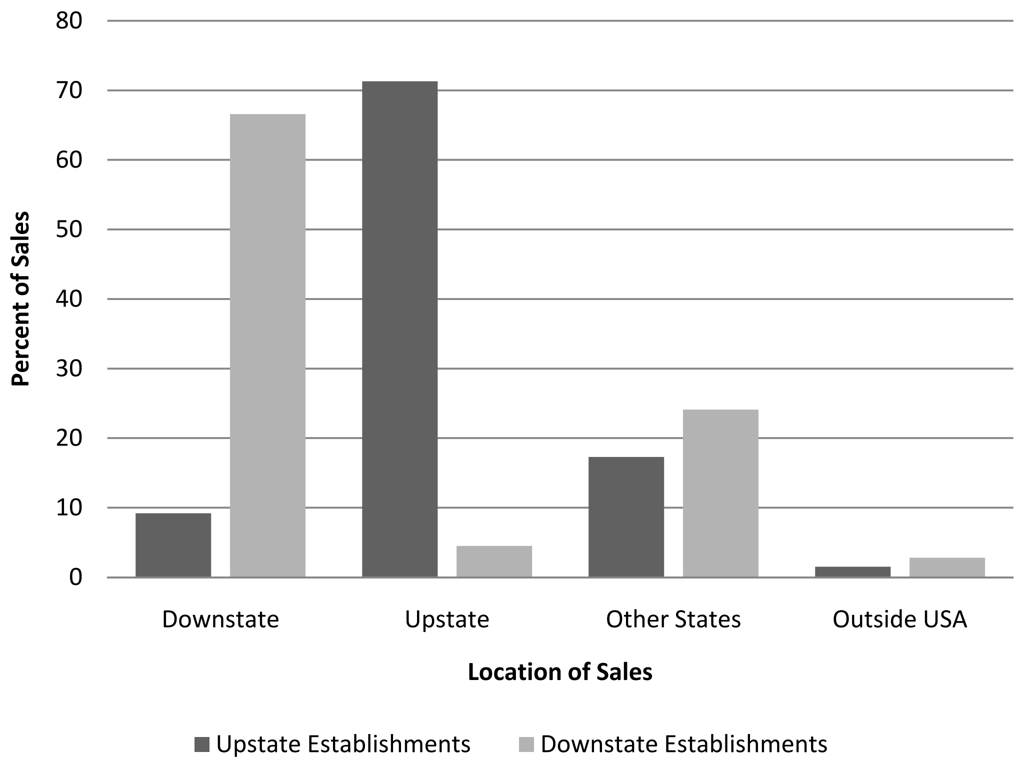

Figure 3.12. Distribution of Plant Sales by Upstate (N=333) and Downstate (N=83) Plants
Source: 2009 NYS Food and Beverage Manufacturing Survey (Note: Downstate includes Rockland, Putnam, and Westchester Counties, the New York City Burroughs, and Long Island)

Similarly, the location of inputs procured tended to be near the location of the plants, with little interaction between upstate and downstate (Figure 3.13). Approximately 71% of upstate firms' raw input costs were sourced from upstate (and identical to the comparable spatial distribution of sales). As expected, local (i.e., downstate) product procurement for downstate food processors was lower (52%) than for upstate firms, but still relatively high. In addition, 28% of product input costs for downstate firms were sourced from other states, with a large share likely from the more immediate tri-state area.

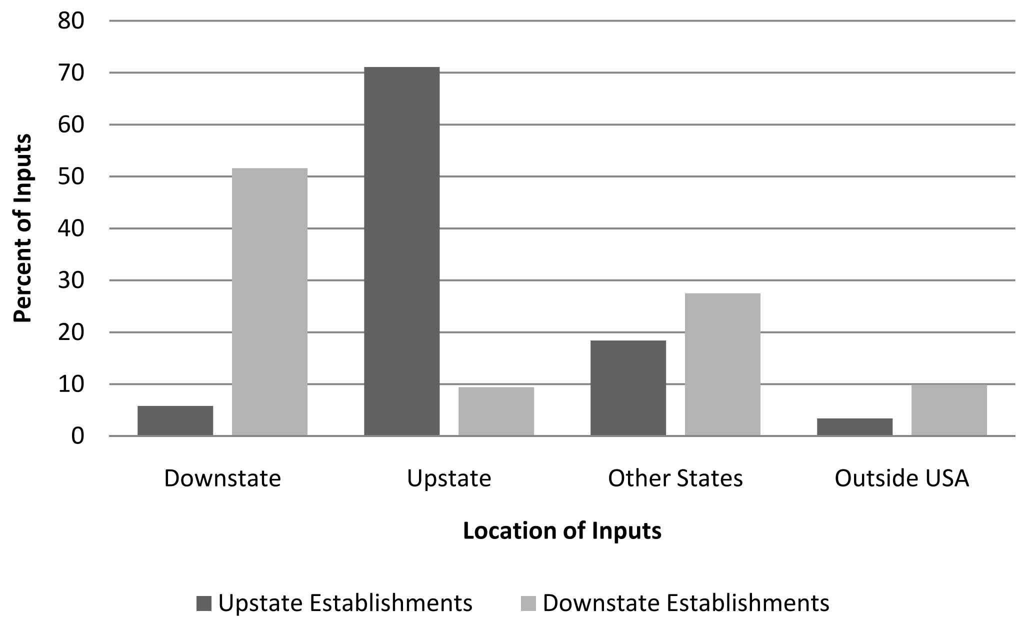

Figure 3.13. Distribution of Raw Product Procurement by Upstate (N=310) and Downstate (N=76) Plants
Source: 2009 NYS Food and Beverage Manufacturing Survey (Note: Downstate includes Rockland, Putnam, and Westchester Counties, the New York City Burroughs, and Long Island)

Collaborative Activities

Processing plants were also asked about the extent of their participation in collaborative activities with other firms. Categories of collaborative activities included group purchasing, shared services, marketing and promotion, legislative affairs, workforce development, and distribution/transportation. The percentages of respondents participating in each activity are shown in Figure 3.14.

The most utilized collaborative activity was group marketing and promotion, followed by legislative affairs and group purchasing. There was, however, considerable variation in utilization across industry categories, as shown in Figure 3.15.

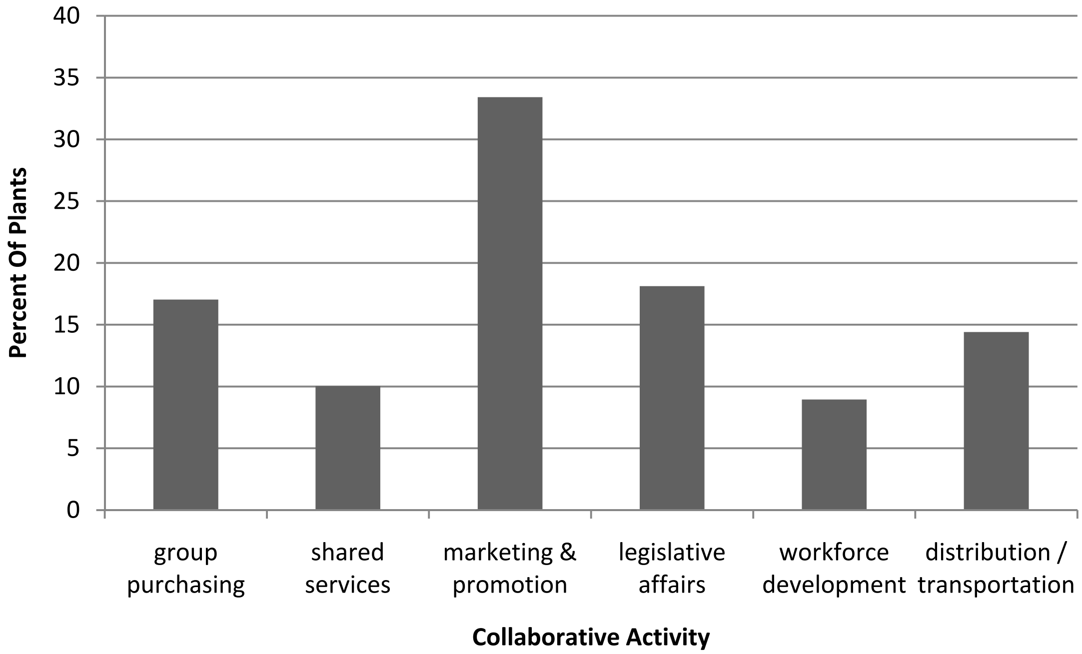

Figure 3.14. Plant Utilization of Firm Collaborative Activities, by Type (N=458*)*
Source: 2009 NYS Food and Beverage Manufacturing Survey

Many of the industries have state-wide organizations to assist their member businesses, such as the maple and winery industries. As a result, 49% of the responding maple producers participated in group marketing and promotion and 28% participated in group legislative affairs. Similarly, 66% of alcoholic beverage producers reported participating in group marketing and 35% participated in legislative affairs. Many fruit and vegetable processors and dairy processors appeared to utilize group marketing as well. Group purchasing was used most by the non-alcoholic beverage industry, with utilization of 40% by respondents.

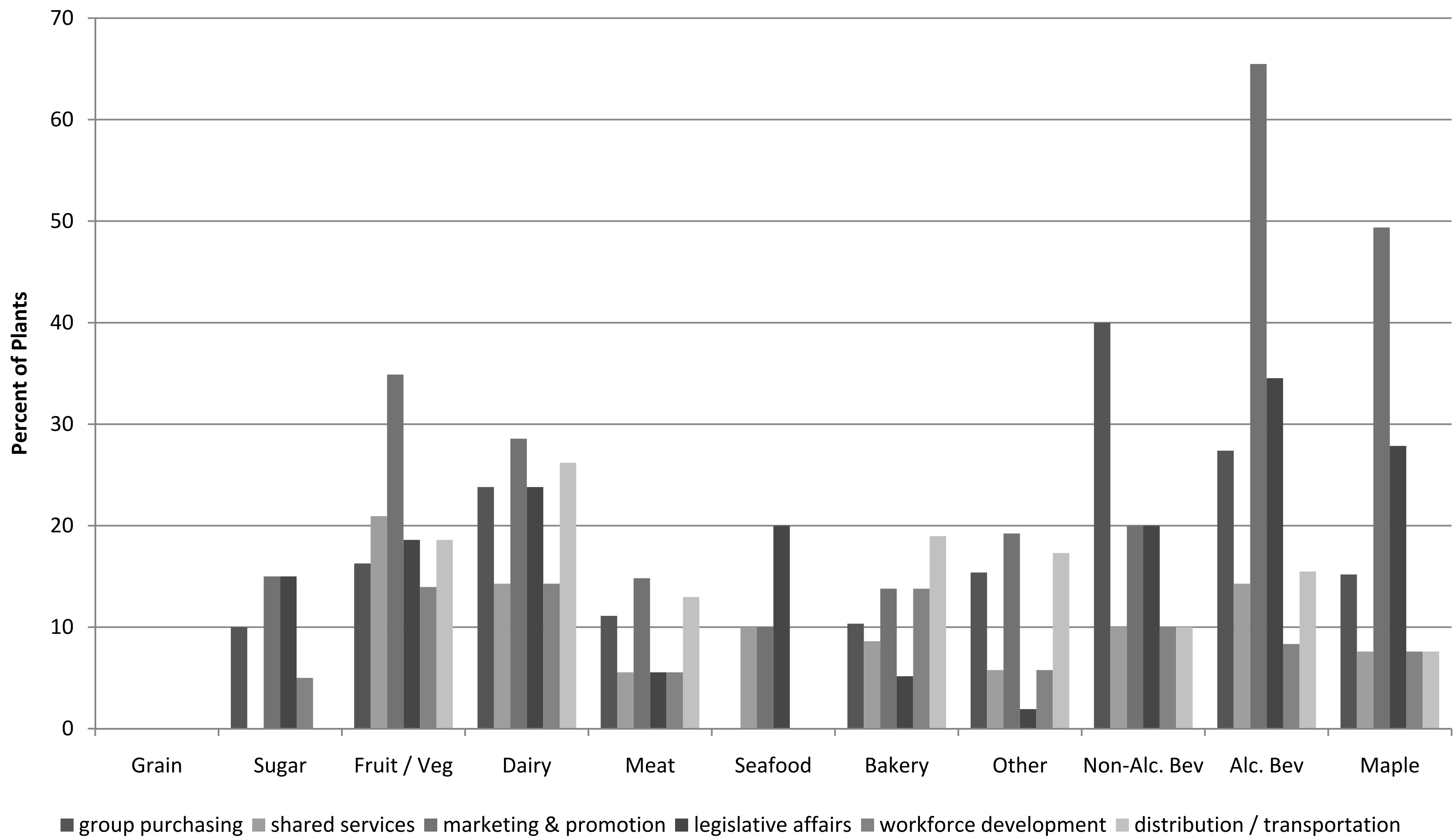

Figure 3.15. Plant Utilization of Firm Collaborative Activities, by Industry Sector (N=458)
Source: 2009 NYS Food and Beverage Manufacturing Survey

A comparison of participation in collaborative activities by firm size shows that smaller plants generally participate in different categories of collaborative activities than large plants (Figure 3.16). Small firms and non-employer firms have the largest percentages of participation in group marketing and promotional activities, with 37% of non-employers and 39% of small plants participating in these activities. Large plants (over 50 employees) had the highest percent participation in group purchasing, legislative affairs, workforce development, and distribution and transportation activities.

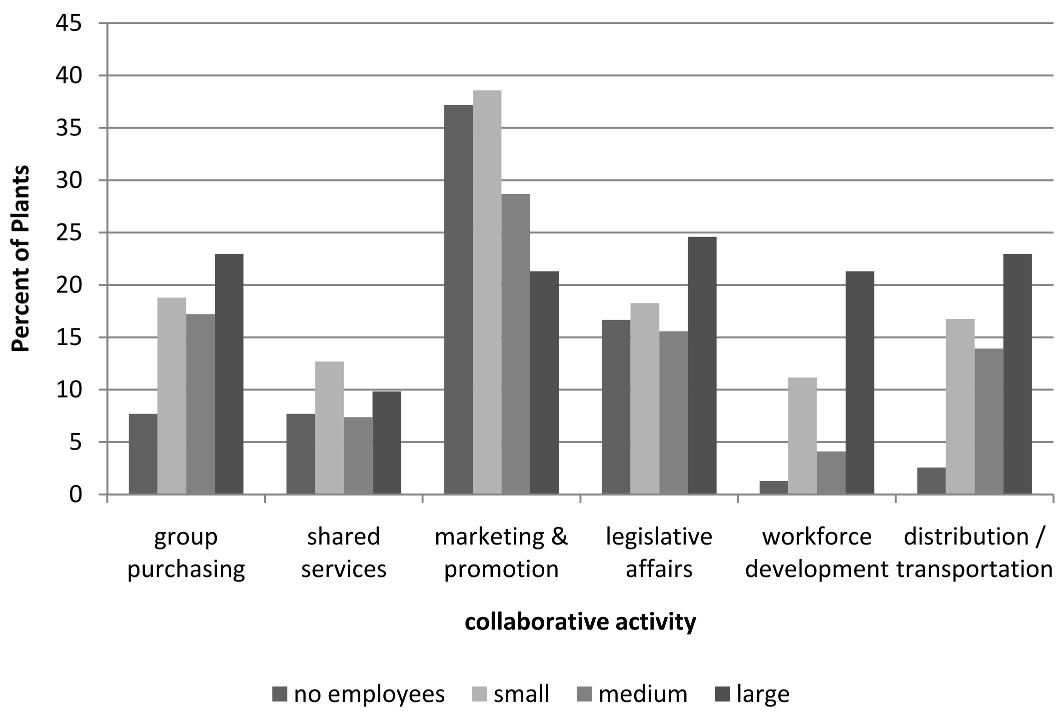

Figure 3.16. Percent of Plants Participating in Collaborative Activities by Size of Plant; non-employer (N=78), small (N=197), medium (N=122), large (N=61)
Source: 2009 NYS Food and Beverage Manufacturing Survey (Note: Firm size categories are defined as: small firms = 1-9 employees, medium firms = 10-49 employees, and large firms = at least 50 employees)

Consumer Trends

The surveyed plants were asked to rate on a one-to-five Likert scale[11] the degree to which various consumer trends affected their business. These trends included: "increased demand for locally produced food", "increased demand for safe, nutritious, and quality food", and "increasing interest in sustainability issues". Although all three consumer trends appeared to be beneficial to most firms, the first two trends were especially so, with "increased demand for locally produced food" rated as "very beneficial" by 46% of plants and "beneficial" by 33% of plants, and "increased demand for safe, nutritious, and quality food" rated as "very beneficial" by 43% of plants and "beneficial" by 37% of plants (Figure 3.17).

"Increased demand for locally produced food" was considered to be a beneficial trend for the majority of all industry sectors except for grain millers (only two of the six grain millers considered this trend "beneficial" or "very beneficial"). Approximately, 89% of alcoholic beverage processors found the trend towards locally produced food as "beneficial" or "very beneficial" (Figure 3.18). Between 65% and 95% of each sector found the "increased demand for safe, nutritious, and quality food" as "beneficial" or "very beneficial". Some industries found "increasing interest in sustainability issues" to be beneficial, such as fruit and vegetable processors, dairy processors, seafood processors, and alcoholic beverage processors, and was relatively less beneficial than 'local' and 'safe/nutritious' across all industry sectors. Few grain millers and sugar and confectionary processors rated this trend as beneficial.

[11] Plants were asked to choose between "Very harmful to your business", "Harmful to your business", "Neither harmful nor beneficial to your business", "Beneficial to your business", "Very beneficial to your business", or "Not Applicable".

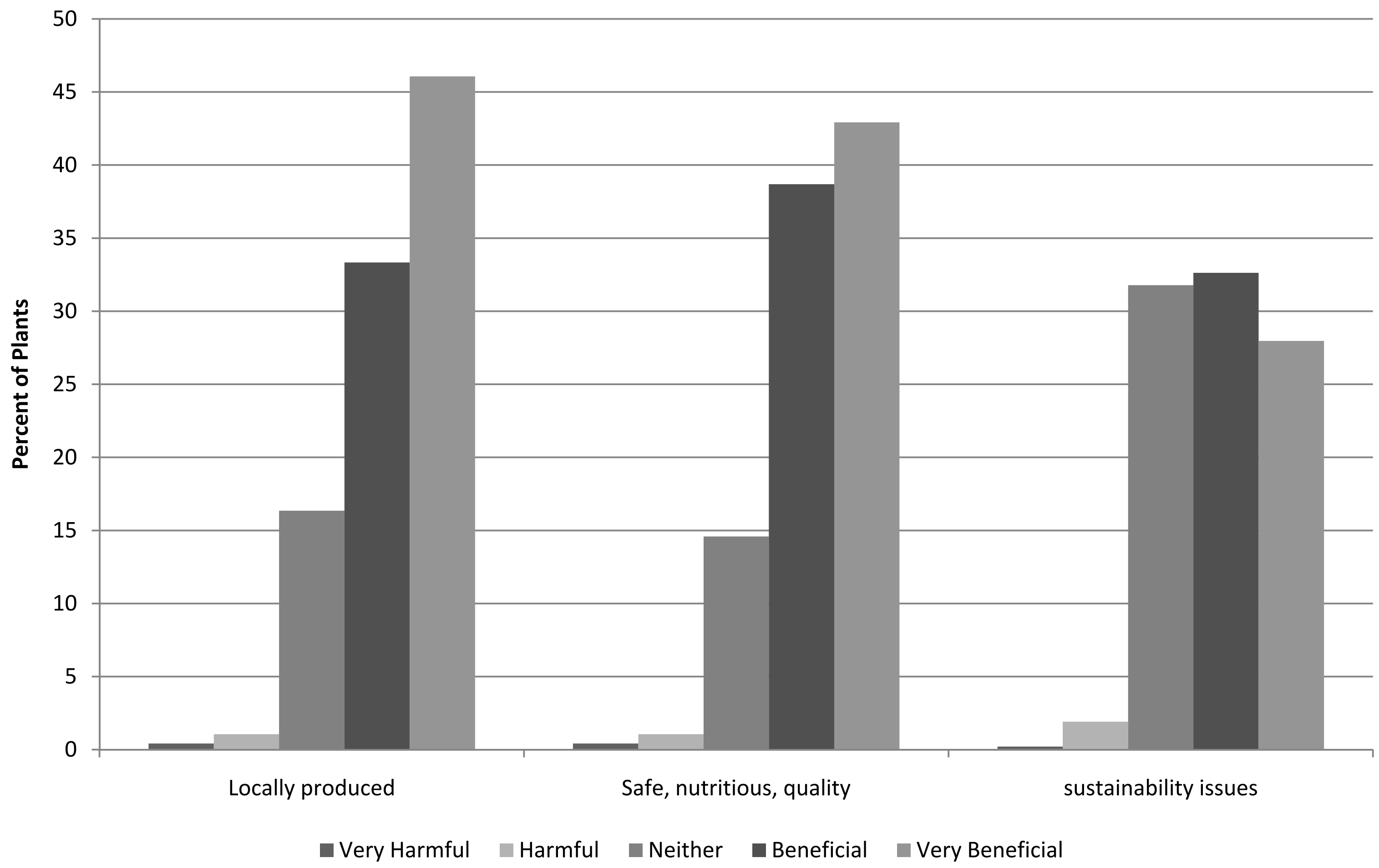

Figure 3.17. Ratings of Benefits of: (1) Increased demand for locally produced food, (2) Increased demand for safe, nutritious, and quality food, (3) Increasing interest in sustainability issues. (N=471)
Source: 2009 NYS Food and Beverage Manufacturing Survey

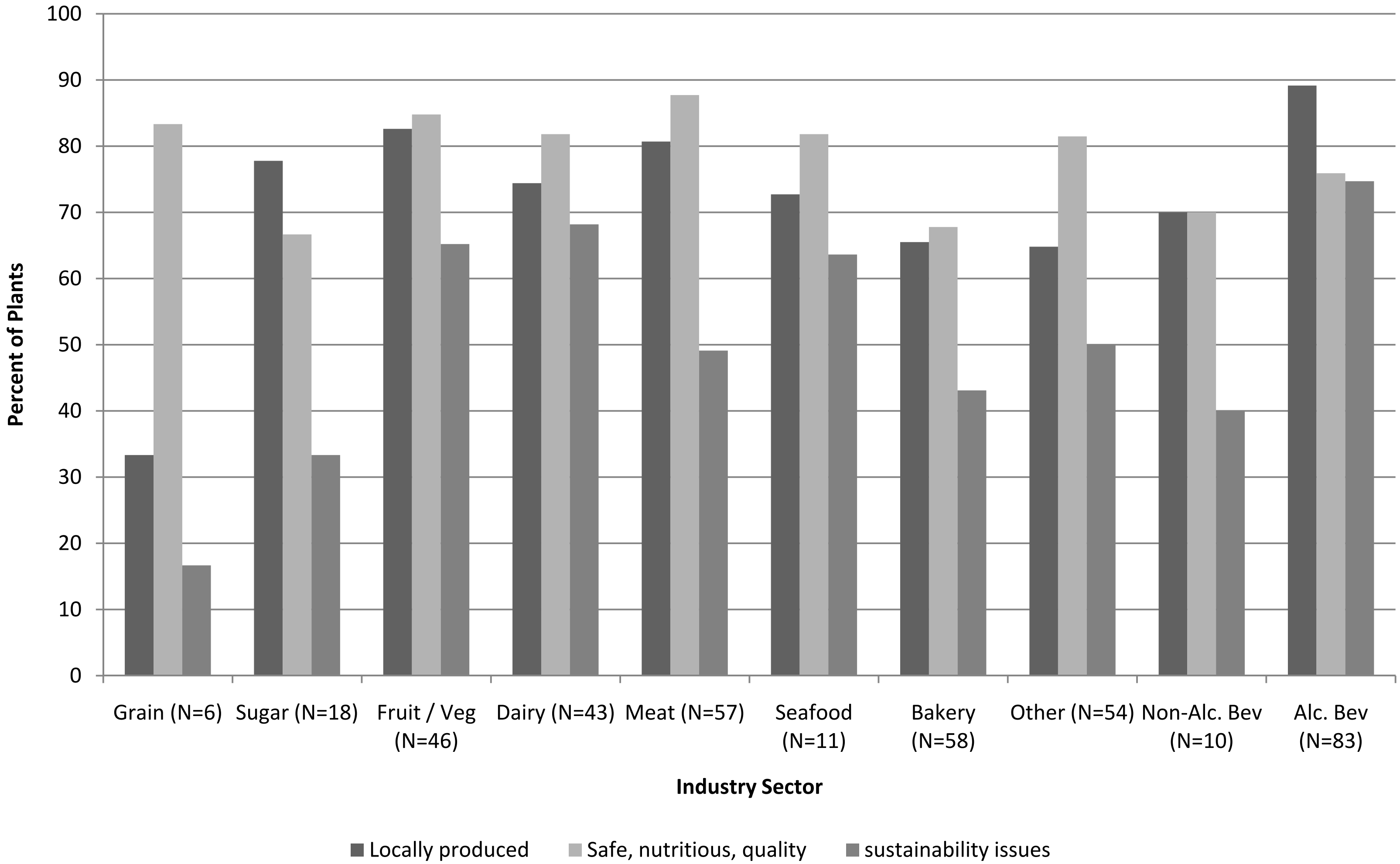

Figure 3.18. Percent of Plants Rating Consumer Trends as “Beneficial” or “Very Beneficial”, by Industry Sector
Source: 2009 NYS Food and Beverage Manufacturing Survey

Plant Growth

To get a perspective on plant economic performance, respondents were asked about past performance and future growth projections based on several different measures (i.e., annual revenue, employee staffing, and capital spending). In all cases, it was evident that there existed substantial heterogeneity in levels of reported growth across firm sizes and industry sectors.

Capital Spending

In terms of capital spending, firms were asked to indicate relative to the current year (2009), what their expected capital spending is for the next one- and three-year periods. Overall, 35% of respondents expected to increase capital spending over the next three years, while 14% expected to decrease spending over the same time period; the rest expected no change or were unsure (Figure 3.19).

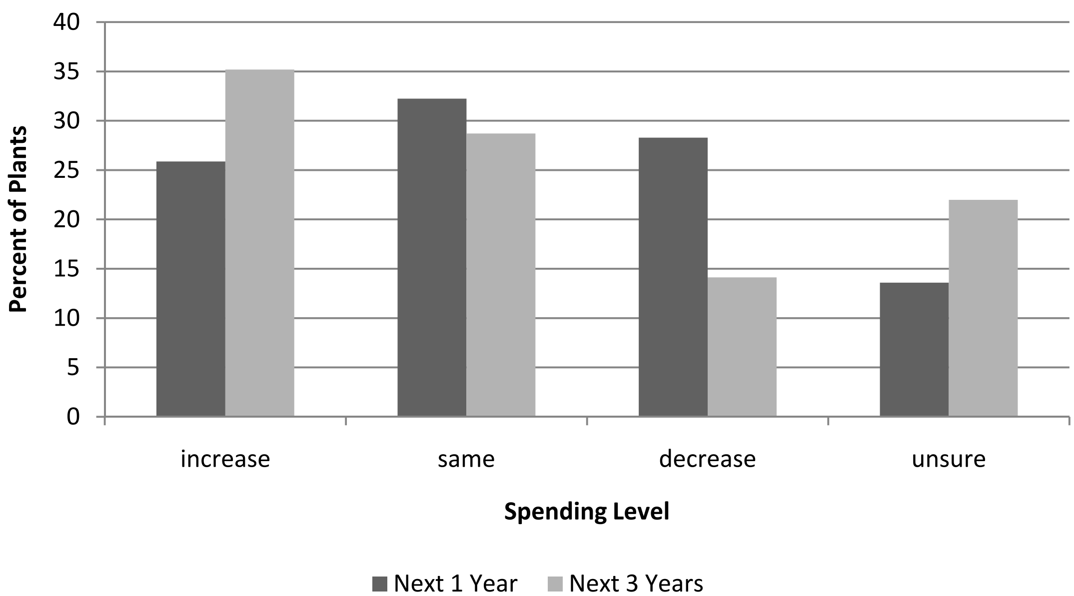

Figure 3.19. Expected Changes in Capital Spending Over the Next One- (N=456) and Three-Year Periods (N=432)
Source: 2009 NYS Food and Beverage Manufacturing Survey

To better understand capital spending by firm size, Table 3.1 shows the planned change in capital spending for the next 1 and three years. As can be seen, increased capital spending expectations are positively related to firm size. Specifically, 48.2% of large firms expect to increase capital spending over the next 3 years, compared with 26.7%, 32.8%, and 38.1% for non-employer, small, and medium sized firms, respectively.

Given the general economic downturn in 2009 (domestically and globally), 1-year spending estimates were more conservative. However, clear short-term reductions in capital investment were more prevalent in small- to medium- sized firms, resulting in negative net spending estimates. In addition, much more short-term uncertainty was apparent based on the increased proportion of firms in the 'unsure' category. More limited access to capital markets and equity financing may also be playing a part in the more conservative and unsure estimates by smaller firms.

Table 3.1. Planned Change in Capital Spending by Firm Size, Percent of Firms, Next 1 Year and Next 3 Years

	Next 1 Year				Next 3 Years			
change in capital spending	non - employer	small	medium	large	non-employer	small	medium	large
increase (%)	26.6	23.3	24.2	36.7	26.7	32.8	38.1	48.2
same (%)	30.4	34.2	31.5	30.0	22.7	30.6	25.4	37.5
decrease (%)	20.3	30.6	31.5	25.0	20.0	14.2	12.7	8.9
not sure (%)	22.8	11.9	12.9	8.3	30.7	22.4	23.7	5.4
net increase (%)	6.3	-7.3	-7.3	11.7	6.7	18.6	25.4	39.3
	(N=79)	(N=193)	(N=124)	(N=60)	(N=75)	(N=183)	(N=118)	(N=56)

Source: 2009 NYS Food and Beverage Manufacturing Survey (Note: Firm size categories are defined as: small firms = 1-9 employees, medium firms = 10-49 employees, large firms = at least 50 employees)
Note: net increase (%) = increase (%) – decrease (%)

Highly heterogeneous capital spending is also evident when comparing expectations across industry sectors (Table 3.2). Other food processors, alcoholic beverage processors, and dairy processors appear to have the highest capital spending expectations. For the next three years, significant variation exists, but most firms (on net) are expecting to increase spending; however a large percentage of fruit and vegetable, meat, seafood, and non-alcoholic beverage processors were unsure of future capital investment. On a one-year horizon, expected capital spending is considerably lower. These numbers were reported during January/February 2009, a time of economic uncertainty and poor national economic performance and outlook. The lack of clear trends in one-year expectations may be a result of these broader uncertain expectations in the national economy.

Employee Staffing

Similar results are exhibited when considering one-year and three-year employee staffing projections. However, expected employee staffing was generally more positive than capital spending. Specifically, 20% of firms expected to increase employee staffing over the next one year, and 37% expected to increase employee staffing over the next three years (Figure 3.20).

Furthermore, over 70% of all plants responding are expecting to maintain or increase staffing levels over the next three years. Such strong expectations reinforce historical trends showing agricultural manufacturing performance well above other manufacturing trends in the state. Only 10% of plants expected to decrease employee staffing over the next year. Similar to capital spending, a higher proportion of large firms expect growth in employee staffing relative to smaller firms (Table 3.3). Over the next year, the majority of responding plants in each sector expected staffing levels to remain the same. Over the next 3 years, other food, alcoholic beverage, and dairy processors had the highest net rates of expected employee growth (Table 3.4), followed more distantly by fruit and vegetable, bakery, and grain operations.

Table 3.2. Planned Change in Capital Spending by Industry Sector, Percent of Firms, Next 1 Year and Next 3 Years

Next 1 Year

change in capital spending	Grain	Sugar	Fruit / Veg	Dairy	Meat	Seafood	Bakery	Other	Non-Alc Bev	Alc Bev	Maple
increase (%)	20.0	18.8	27.3	36.6	20.4	0.0	33.3	26.9	50.0	29.6	24.3
same (%)	40.0	56.3	34.1	29.3	32.7	27.3	25.5	34.6	0.0	29.6	47.3
decrease (%)	40.0	37.5	18.2	29.3	36.7	36.4	39.2	25.0	37.5	35.8	18.9
not sure (%)	20.0	6.3	18.2	4.9	22.4	36.4	13.7	15.4	37.5	4.9	17.6
net increase (%)	-20.0	-18.7	9.1	7.3	-16.3	-36.4	-5.9	1.9	12.5	-6.2	5.4
	(N=6)	(N=19)	(N=43)	(N=41)	(N=55)	(N=11)	(N=57)	(N=53)	(N=10)	(N=81)	(N=80)

Next 3 Years

change in capital spending	Grain	Sugar	Fruit / Veg	Dairy	Meat	Seafood	Bakery	Other	Non-Alc Bev	Alc Bev	Maple
increase (%)	40.0	25.0	38.6	48.8	16.3	18.2	29.4	48.1	12.5	46.9	27.0
same (%)	20.0	43.8	20.5	26.8	36.7	18.2	33.3	25.0	12.5	25.9	32.4
decrease (%)	20.0	12.5	6.8	12.2	16.3	9.1	13.7	11.5	37.5	16.0	16.2
not sure (%)	20.0	18.8	34.1	12.2	30.6	54.5	23.5	15.4	37.5	11.1	24.3
net increase (%)	20.0	12.5	31.8	36.6	0.0	9.1	15.7	36.6	-25.0	30.9	10.8
	(N=5)	(N=16)	(N=44)	(N=41)	(N=49)	(N=11)	(N=51)	(N=52)	(N=8)	(N=81)	(N=74)

Source: 2009 NYS Food and Beverage Manufacturing Survey

Note: net increase (%) = increase (%) – decrease (%)

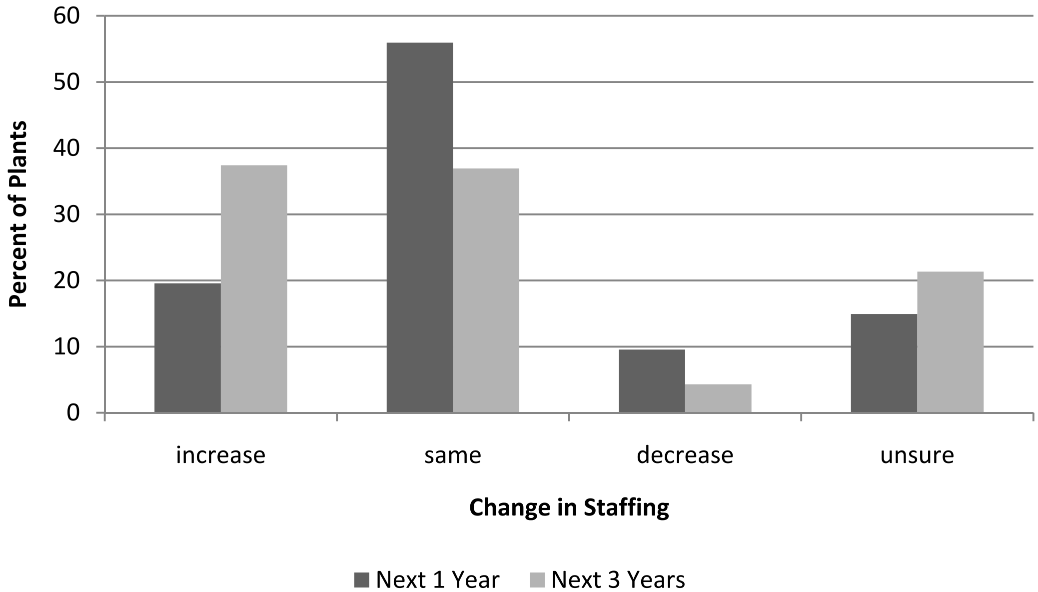

Figure 3.20. Expected Changes in Employee Staffing Over the Next One- (N=427) and Three Year Periods (N=417)
Source: 2009 NYS Food and Beverage Manufacturing Survey

Table 3.3. Planned Change in Employee Staffing by Firm Size; Next 1 Year, Next 3 Years

	Next 1 Year				Next 3 Years			
change in employee staffing	non - employer	small	medium	large	non-employer	small	medium	large
increase (%)	6.0	18.9	27.3	21.4	17.2	34.1	47.0	51.9
same (%)	47.8	64.9	45.5	58.9	37.5	42.9	25.6	40.7
decrease (%)	1.5	5.9	19.0	10.7	0.0	4.4	6.8	3.7
not sure (%)	44.8	10.3	8.3	8.9	45.3	18.7	20.5	3.7
net increase (%)	4.5	13.0	8.3	10.7	17.2	29.7	40.2	48.2
	(N=67)	(N=185)	(N=121)	(N=56)	(N=64)	(N=182)	(N=117)	(N=54)

Source: 2009 NYS Food and Beverage Manufacturing Survey (Note: Firm size categories are defined as: small firms = 0-9 employees, medium firms = 10-49 employees, large firms = at least 50 employees)
Note: net increase (%) = increase (%) – decrease (%)

Table 3.4. Planned Change in Employee Staffing by Industry Sector, Percent of Firms, Next 1 Year and Next 3 Years

Next 1 Year

change in capital spending	Grain	Sugar	Fruit / Veg	Dairy	Meat	Seafood	Bakery	Other	Non-Alc Bev	Alc Bev	Maple
increase (%)	16.7	11.1	20.0	28.9	14.3	0.0	24.1	25.5	10.0	26.6	9.1
same (%)	66.7	44.4	60.0	60.5	57.1	54.5	44.4	51.0	60.0	48.1	74.2
decrease (%)	0.0	11.1	5.0	5.3	12.5	18.2	16.7	9.8	10.0	13.9	0.0
not sure (%)	16.7	33.3	15.0	5.3	16.1	27.3	14.8	13.7	20.0	11.4	16.7
net increase (%)	16.7	0.0	15.0	23.6	1.8	-18.2	7.4	15.7	0.0	12.7	9.1
	(N=6)	(N=18)	(N=40)	(N=38)	(N=56)	(N=11)	(N=54)	(N=51)	(N=10)	(N=79)	(N=66)

Next 3 Years

change in capital spending	Grain	Sugar	Fruit / Veg	Dairy	Meat	Seafood	Bakery	Other	Non-Alc Bev	Alc Bev	Maple
increase (%)	33.3	23.5	41.9	51.4	23.1	20.0	37.3	61.7	12.5	51.9	12.3
same (%)	33.3	35.3	23.3	32.4	46.2	50.0	27.5	19.1	50.0	30.9	66.2
decrease (%)	0.0	0.0	9.3	8.1	5.8	0.0	3.9	2.1	0.0	4.9	1.5
not sure (%)	33.3	41.2	25.6	8.1	25.0	30.0	31.4	17.0	37.5	12.3	20.0
net increase (%)	33.3	23.5	32.6	43.3	17.3	20.0	33.4	59.6	12.5	47.0	10.8
	(N=6)	(N=17)	(N=43)	(N=37)	(N=52)	(N=10)	(N=51)	(N=47)	(N=8)	(N=81)	(N=65)

Source: 2009 NYS Food and Beverage Manufacturing Survey
Note: net increase (%) = increase (%) – decrease (%)

Annual Revenue Growth

The final measure of plant growth considered was in terms of annual gross revenues. The distribution of average annual revenue growth for the past three years is shown in Figure 3.21. The majority of respondents reported positive growth rates, with 52% reporting at least 5% average annual revenue growth. However, this could be the result of selection bias as firms experiencing negative revenue growth over the past three years would be more likely to have stopped operating by the time of the survey. That said, there were a number of firms reporting negative growth, some quite strongly.

Average revenue growth by firm size is shown in Figure 3.22. Again, the lack of clear trends in one-year expectations is likely due, in part, to the uncertain economic climate experienced during the administration of the survey. In addition, there is no clear trend between firm size and revenue growth. While this may also be due to the particular economic conditions that existed at the time, revenue growth based only on firm-size is likely inadequate when considered in isolation (e.g., without also considering age of firm, industry sector, location, etc.).

Figures 3.23 and 3.24 show average revenue growth by industry sector and region. Similar to the two previous growth measures, other food processors and alcoholic beverage producers have the highest experienced and expected revenue growth rates. Fruit and vegetable processors also have a high rate of expected growth in the next three years.

Regionally, Western New York and the North Country regions reported the lowest growth rates over the past 3 years, while Long Island and the Capital region reported the highest rates of growth. The empirical modeling that follows in later chapters seeks to disentangle the variation in firm revenue growth based on a set of firm, industry, and spatial factors. The empirical results from these models suggest regional effects are largely the result of firm size or sector representation in these areas rather than particular regional business climate factors.

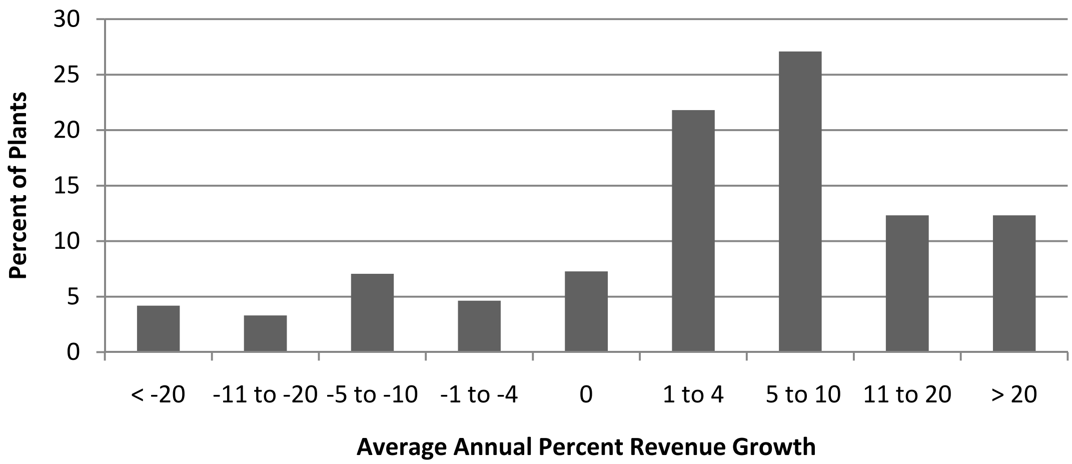

Figure 3.21. Distribution of Average Annual Revenue Growth for Past 3 Years (N=454)
Source: 2009 NYS Food and Beverage Manufacturing Survey

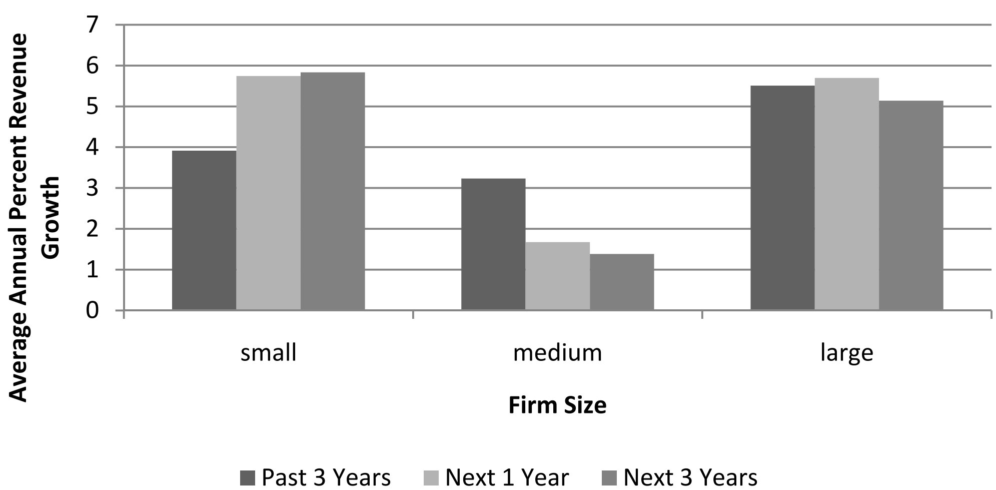

Figure 3.22. Average Annual Revenue Growth by Firm Size for Past 3 Years (N=454), Next 1 Year (N=447), and Next 3 Years (N=435)
Source: 2009 NYS Food and Beverage Manufacturing Survey (Note: Annual revenue growth was reported in a categorical format (see Appendix A). Size class averages were calculated using the midpoint values of the categories.)

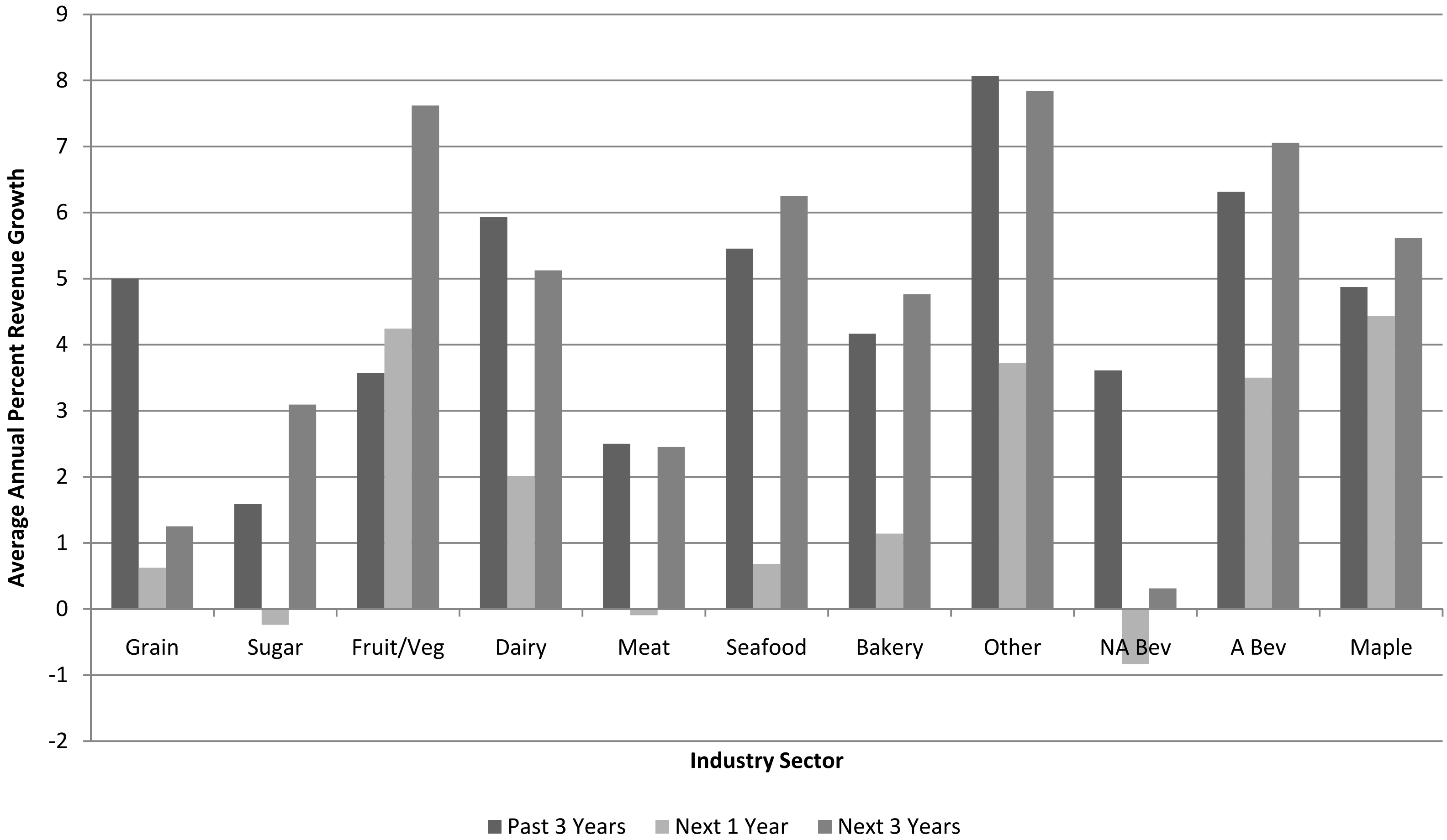

Figure 3.23. Average Annual Revenue Growth by Industry Sector, Past 3 Years (N=454), Next 1 Year (N=447), Next 3 Years (N=435)
Source: 2009 NYS Food and Beverage Manufacturing Survey (Note: Annual revenue growth was reported in a categorical format (see Appendix A). Size class averages were calculated using the midpoint values of the categories.)

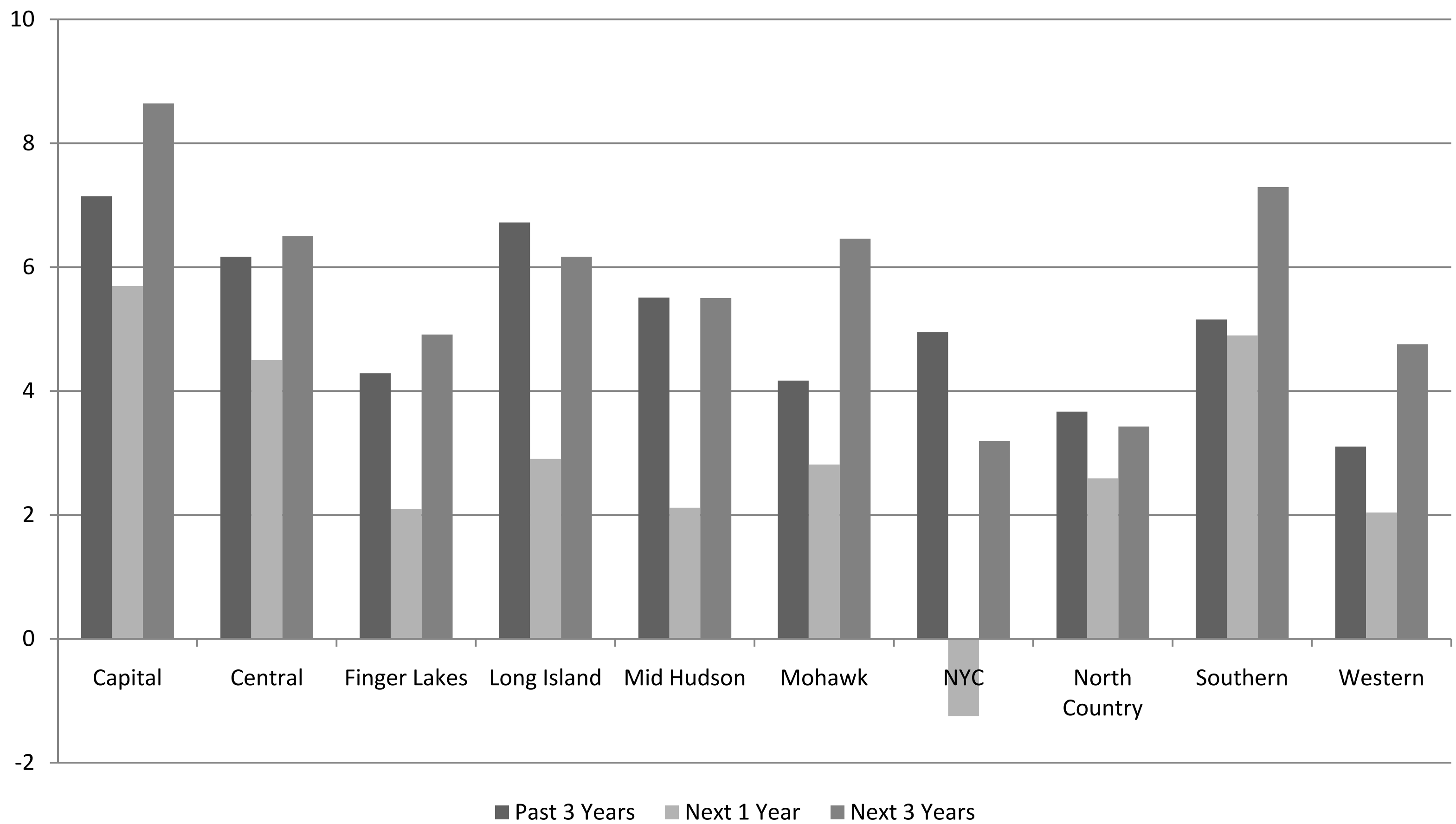

Figure 3.24. Average Annual Revenue Growth by Region, Past 3 Years (N=454), Next 1 Year (N=447), Next 3 Years (N=435)
Source: 2009 NYS Food and Beverage Manufacturing Survey (Note: Annual revenue growth was reported in a categorical format (see Appendix A). Size class averages were calculated using the midpoint values of the categories.)

Firm Retention

To better assess the general NYS business climate on firm performance, respondents were asked to identify their level of agreement with the statement “New York State is a great place to do business”. Overall, 31% of responding plants either agreed or strongly agreed with this statement (Figure 3.25).

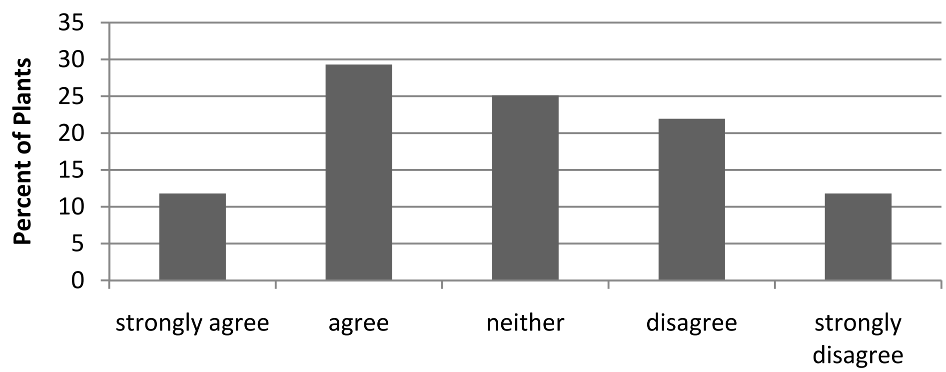

Figure 3.25. Level of Agreement with the Statement “New York State is a great place to do business”, by Percent of Respondents (N=474)
Source: 2009 NYS Food and Beverage Manufacturing Survey

Maple producers and seafood processors had the most positive opinion of doing business in New York, while other food processors, both alcoholic and non-alcoholic beverage producers, and meat processors had the most negative opinion of doing business in NYS (Figure 3.26). Interestingly, some of the industry categories with the lowest opinions of doing business in NYS had the highest growth rates (e.g., alcoholic beverage processors and other food manufacturers). Possibly, these are relatively new and/or fast-growing industries and state business regulations more aptly addressed the older industry sectors. Conversely, firms that have been operating in NYS for decades may have found ways to benefit from the unique attributes of the state’s business environment, while younger firms are still trying to find these benefits which NYS provides.

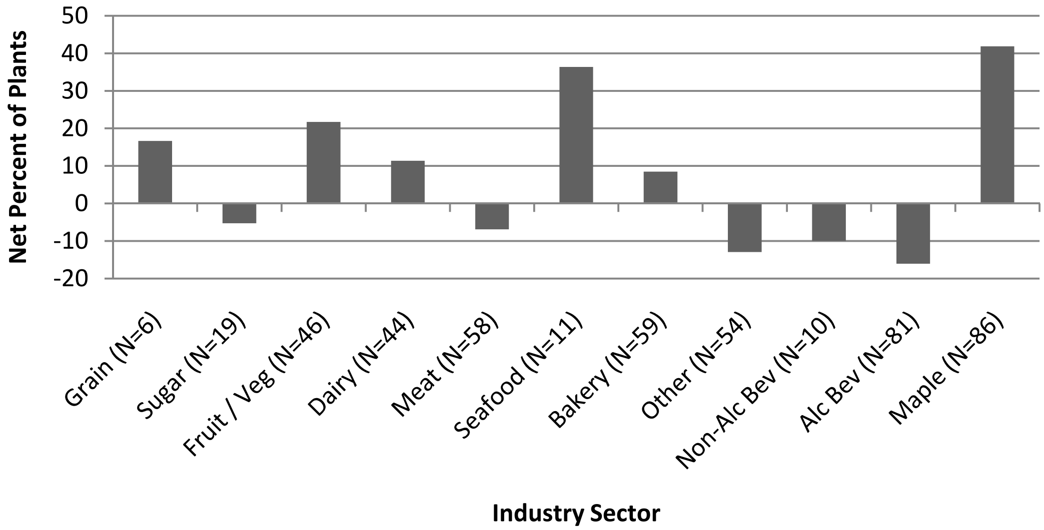

Figure 3.26. Net Percent of Firms Agreeing With the Statement "New York State is a great place to do business", by Industry Sector
Source: 2009 NYS Food and Beverage Manufacturing Survey (Note: Net number of agreeing plants was calculated as the number of plants that strongly agree or agree minus the number of plants that disagree or strongly disagree).

The issue of firm performance is often times discussed in concert with firm retention and the concern of plants moving operations elsewhere. To better understand these issues, firms were asked to what degree they were considering moving out of the state. Only a small percentage of firms were actively considering moving out of state; specifically, 79% of respondents were not considering moving out of state at all, and less than 2% were aggressively considering moving out of state (Figure 3.27). While this is obviously skewed by the fact that the sample contains perennial crop producers such as wineries and maple processors, the results remain similar when looking at more traditional "bricks and mortar" firms that may be more easily adaptable to move operations (Figure 3.28).

There appears to be little effect of firm size on the consideration of moving out of state. While, on average, medium and large firms were considering moving out of state slightly more than the small firms (although not statistically different), approximately 75% of medium and large firms were not considering moving out of state at all (Figure 3.29).

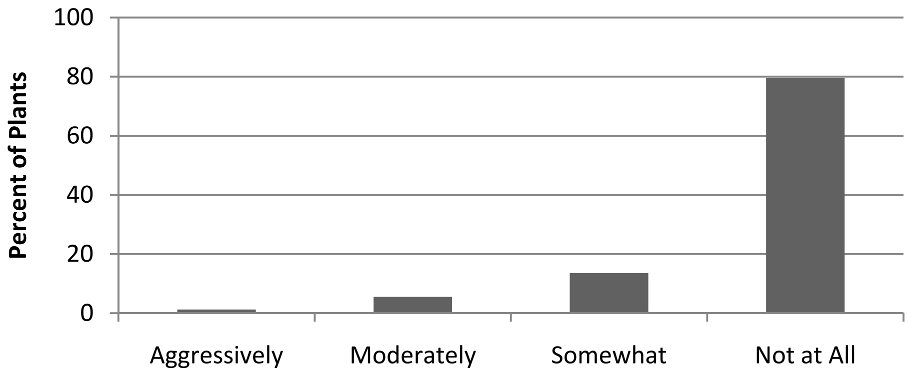

Figure 3.27. Degree to Which Firms Are Considering Moving Out of State (N=471)
Source: 2009 NYS Food and Beverage Manufacturing Survey

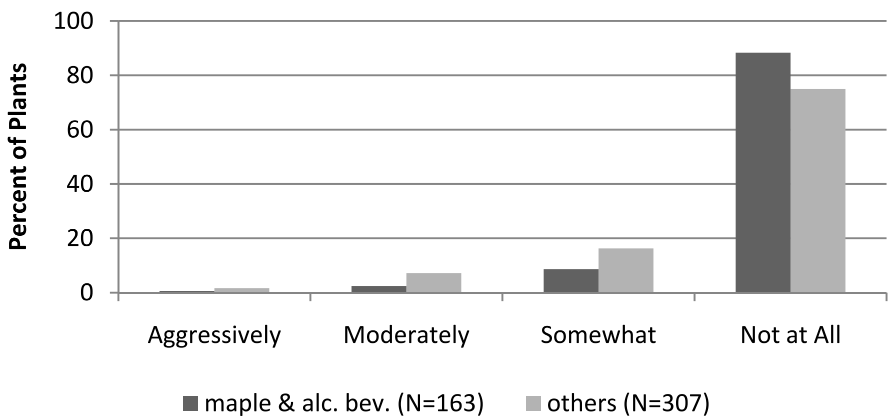

Figure 3.28. Degree to Which Firms Are Considering Moving Out of State, Comparison of Maple and Alcoholic Beverage Processors vs. Other Manufacturing Sectors
Source: 2009 NYS Food and Beverage Manufacturing Survey

A comparison of the degree to which firms are considering moving out of state by industry sector also reveals that there is little difference between industries. In addition, even amongst firms who consider NYS to be harmful to business, there is little change in the level of consideration of moving out of state (Figure 3.30).

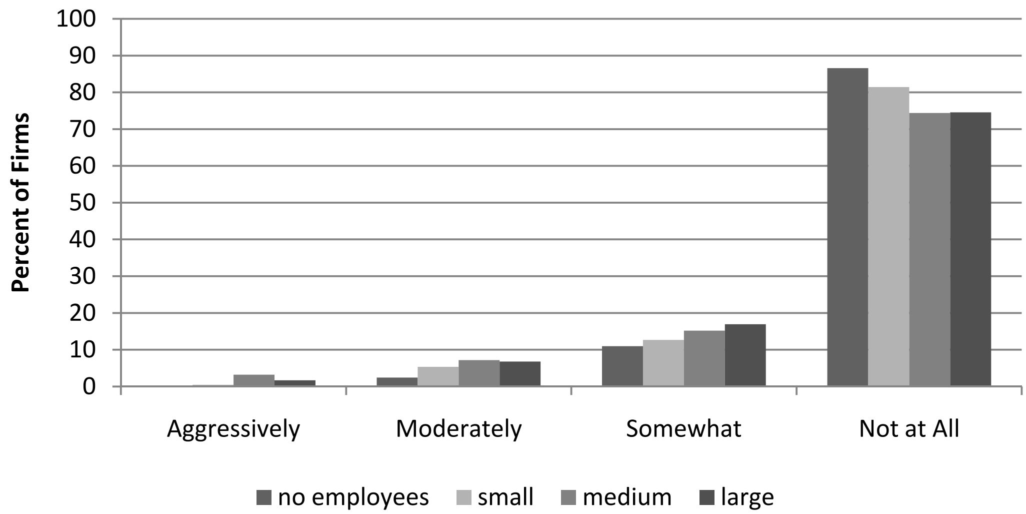

Figure 3.29. Degree to Which Firms Are Considering Moving Out of State, Comparison by Firm Size; No Employee (N=82), Small (N=205), Medium (125), Large (59)
Source: 2009 New York State Food and Beverage Manufacturing Survey (Note: small = 1-9 employees, medium = 10-49 employees, large = more than 50 employees)

Even though many firms seem to consider the NYS business environment to be harmful to operations, few firms appear to be leaving the state to conduct operations elsewhere. Presumably, even the more traditional "brick and mortar firms" have strong ties to their local communities, and moving out of state would make it difficult to access these types of input markets. Based on these results, it would appear that traditional firm retention issues and responses are of little consequence to the food and beverage manufacturers in NYS. However, strategies to keep existing firms economically viable and to aid in the creation of new establishments may be more beneficial than strategies specifically targeted to keep existing firms from moving elsewhere. To this end, we will focus our attention on a more detailed analysis of the business factors affecting the performance of existing firms in the state.

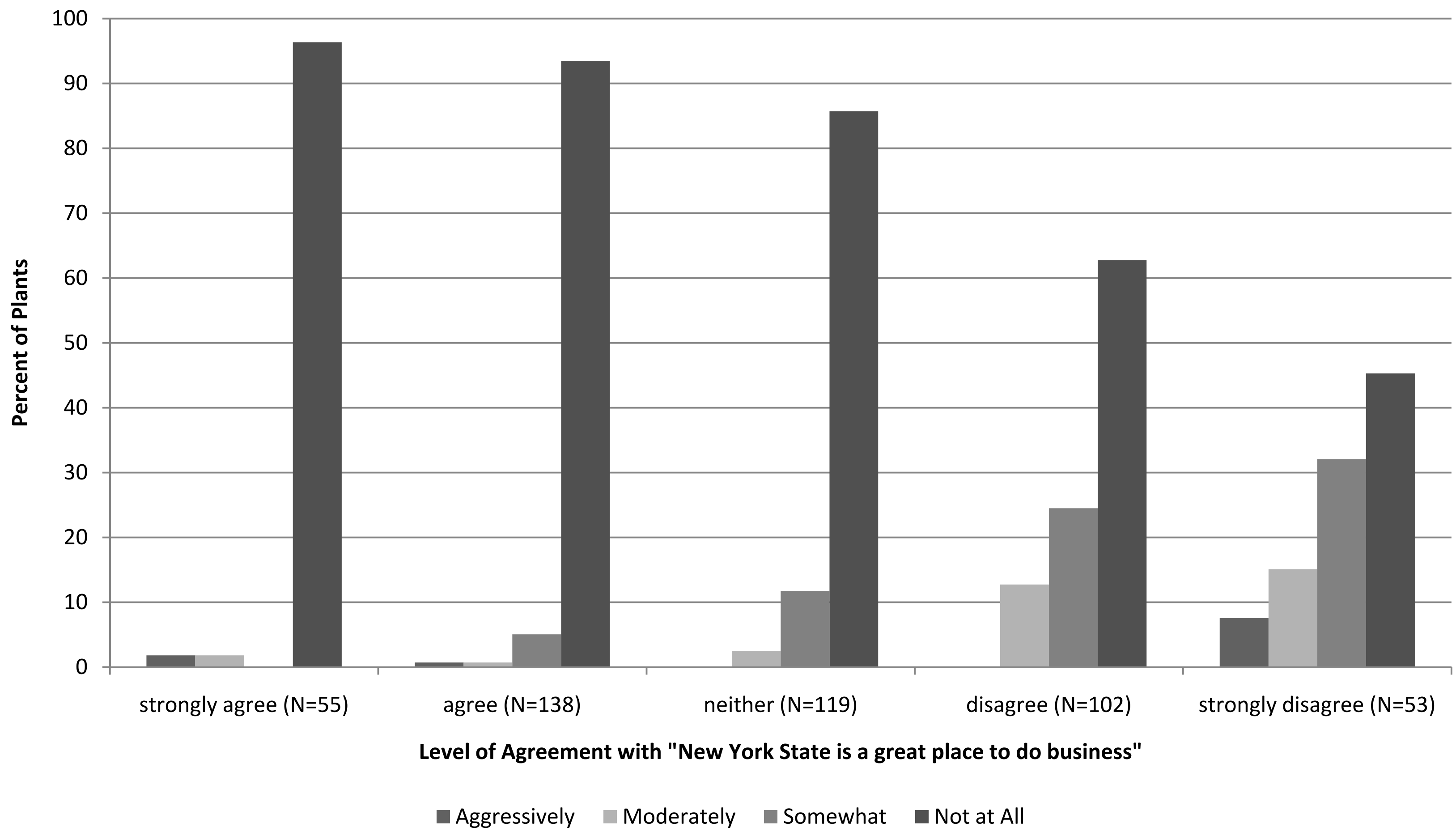

Figure 3.30. Degree to Which Firms Are Considering Moving Out of State, Comparison by Level of Agreement with the statement "New York State is a great place to do business"
Source: 2009 NYS Food and Beverage Manufacturing Survey

Business Environment Factors

To identify and rank both the impediments and beneficial attributes to operating food and beverage manufacturing plants in NYS, respondents were asked to assess the impact on their plant of a number of qualities or attributes of the state's business environment. Respondents ranked the 'business factors' on a five-point Likert scale, ranging from 1 (very harmful to your business) to 5 (very beneficial to your business). Table 3.5 describes the 23 business factors and their average score ranked by the scaled ratings.

Table 3.5. Description of Business Factor Variables, Ordered by Mean of Rating

Variable	Description	Mean
l	Quality of State college and university research, outreach, and assistance	3.87
v	Proximity of customer markets	3.83
b	Quality of communication infrastructure	3.80
k	Your region's overall quality of life	3.70
q	State branding, promotional and marketing campaigns	3.68
r	Regional or local branding activities and efforts	3.59
a	Quality of transportation infrastructure	3.58
t	Availability of trucking services	3.54
w	Proximity of input suppliers	3.54
u	Availability of product distribution services	3.50
s	Availability of alliances and collaborations with other firms	3.48
e	State support for energy efficiency and renewables	3.37
c	Level of State initiatives & growth incentives to support business growth	3.24
n	Availability of management and other professional staff	3.23
m	Availability of workers with the skills your business requires	3.23
d	State support for improved environmental practices	3.21
f	Ability to enter into Public-Private partnerships	3.18
p	Availability of workforce training opportunities	3.13
o	Labor force wage rates	2.87
j	The cost of living for your employees	2.66
i	State- and local-level governmental regulations and permitting procedures	2.47
h	Other costs of doing business	2.17
g	State-level costs of doing business	1.98

Source: 2009 New York State Food and Beverage Manufacturing Survey
Note: Factors were rated on a five category Likert scale; 1=very harmful to business, 2=harmful to business, 3=neither harmful nor beneficial to business, 4=beneficial to business, 5=very beneficial to business.

The most beneficial business environment factors to respondents related to university assistance, market access, and infrastructure availability. The most harmful qualities of the NYS business environment included state and local government regulations and state-level costs of doing business. In terms of overall ranking, those ranked the strongest can give some indications of potential unexploited opportunities and advantages to operating in state, while those near the bottom can be interpreted as important barriers to address or overcome.

Principal Components Analysis

Since there are many different business factors considered, it can be difficult to establish general conclusions by analyzing each business factor individually. Moreover, many of the business factors are closely related to each other, i.e. the state-level costs of doing business and state government regulations, or availability of workers and availability of management. Therefore, it is useful to group the business factors which empirically have similar responses and then attempt to interpret the meanings of these groupings.

The statistical technique Principal Components Analysis (PCA) is used to reduce a large number of correlated factors into a smaller number of uncorrelated 'principal components'. We define the *i*th Principal Component (PC) mathematically as a linear combination of the set $\boldsymbol{x}$, the individual factors (i=1,…,k), or:

(3.1) $$PC_i = \boldsymbol{\alpha}_i \boldsymbol{x} = \alpha_{i1}x_1 + \alpha_{i2}x_2 + \cdots + \alpha_{ik}x_k$$

Then, the $k < 23$ principal components, each uncorrelated to each other, are solved to maximize variance.

When the empirical means are subtracted from the data to produce the demeaned data matrix of business factors X, the Principal Component solution Y is given by:

(3.2) $$\boldsymbol{Y}^T = \boldsymbol{X}^T\boldsymbol{W} = \boldsymbol{V}\Sigma$$

where $\boldsymbol{V}\Sigma\, \boldsymbol{W}^T$ is the singular value decomposition of $\boldsymbol{X}^T$ (Joliffe, 2002).

The solution is solved empirically by first demeaning each of the k factors and then forming the $k \times k$ correlation matrix of the demeaned factors ($\boldsymbol{R}$). Next, the initial principal component solutions are extracted by solving for the eigenvalues, λ_i (i=1,…,k), that satisfy the equation $|\boldsymbol{R} - \lambda_i \mathbf{I}| = 0$, where $\mathbf{I}$ is the identity matrix (Guo et al., 2009).

The eigenvalues and associated eigenvectors are then examined to determine the number of Principal Components which should be included in the reduced dataset. The magnitude of the eigenvalue represents the amount of variance explained by the corresponding Principal Component; i.e. a principal component with a large eigenvalue explains a large amount of the original variance. Thus, since the aim of the procedure is to reduce the number of variables while simultaneously explaining the maximum amount of variance, the principal components with the largest eigenvalues will be used to create the reduced dataset. Commonly, an eigenvalue greater than one indicates that the principal component should be used, although the exact number of principal components used has to be made in a subjective manner based on the value of each additional principal component and the eventual interpretability of results.

The ratings of the 23 business environment factors were analyzed using this method and the initial principal component solution was calculated using the 'pca' function in Stata MP 11.0 (Table 3.6). A reduced dataset was estimated with both five and six principle components. The analysis with five principal components appeared to have a more meaningful interpretation, so its results will be presented. These five principal components represent 56% of the variance from the original 23 business environment factors.

Table 3.6. Principal Component Solution of NYS Business Factors

Component	Eigenvalue	% of Variance	Cumulative % of Variance
1	6.54	28.44	28.44
2	2.08	9.02	37.46
3	1.71	7.44	44.90
4	1.34	5.82	50.71
5	1.24	5.40	56.11
6	1.09	4.75	60.86
7	0.97	4.21	65.07
8	0.89	3.89	68.96
9	0.79	3.42	72.37
10	0.69	3.00	75.38
11	0.64	2.79	78.16
12	0.62	2.71	80.87
13	0.56	2.45	83.32
14	0.53	2.32	85.64
15	0.50	2.17	87.81
16	0.45	1.97	89.79
17	0.43	1.86	91.65
18	0.40	1.73	93.38
19	0.37	1.59	94.97
20	0.36	1.56	96.53
21	0.32	1.37	97.90
22	0.27	1.17	99.07
23	0.21	0.93	100.00

Note: Calculated using Stata MP 11.0

The relation between the original variables and the derived principal components are determined using factor loadings. The factor loadings are correlation coefficients between the original set of variables and the reduced number of principal components. By examining these factor loadings, meanings can be assigned to the principal components.

Commonly, a rotation method is used to adjust the factor loadings. The unrotated matrix of factor loadings is difficult to interpret because the factor loadings are large for the first principal component and then decrease for each subsequent principal component. Rotation methods balance the loadings between each principal component and makes interpretation easier without changing the overall results. The VARIMAX rotation method, the most common technique, finds the linear combination of the principal components (called the rotation) which maximizes the factor loadings (Abdi, 2003). After the factor loadings are rotated using the VARIMAX method, each principal component is highly correlated with a set of the original variables and nearly uncorrelated with the rest. The set of factor loadings were computed for the five principal components and rotated by the VARIMAX method using the ‘factor’ and ‘rotate’ commands in Stata MP 11.0 (Table 3.7).

Table 3.7. Varimax Rotated Factor Loadings on NYS Business Factors

Variable	PC 1	PC 2	PC 3	PC 4	PC 5
a	0.08	0.03	**0.45**	0.32	0.17
b	0.10	0.02	**0.40**	0.33	0.20
c	0.27	0.23	0.15	**0.58**	0.19
d	0.31	0.28	0.14	**0.59**	0.02
e	0.19	0.21	0.10	**0.67**	0.14
f	0.26	0.16	0.11	**0.36**	0.21
g	**0.75**	0.09	0.05	0.18	-0.01
h	**0.76**	0.10	0.07	0.13	0.12
i	**0.66**	0.09	0.16	0.23	0.04
j	**0.57**	0.12	0.06	0.01	0.24
k	0.15	0.28	**0.35**	0.00	0.17
l	0.03	**0.43**	0.21	0.07	0.16
m	0.21	0.16	0.26	0.12	**0.60**
n	0.06	0.08	0.22	0.17	**0.50**
o	**0.47**	0.07	0.01	0.03	0.35
p	0.11	0.22	0.10	0.17	**0.57**
q	0.13	**0.77**	0.03	0.14	0.07
r	0.10	**0.78**	0.09	0.17	0.09
s	0.08	**0.42**	0.14	0.20	0.21
t	0.03	0.09	**0.45**	0.26	0.33
u	0.14	0.05	**0.54**	0.30	0.34
v	0.10	0.15	**0.64**	0.02	0.07
w	0.16	0.16	**0.54**	0.10	0.07

Note: Calculated using Stata MP 11.0

To interpret the meanings of the five principal components, the variables with which each principle component shares the largest factor loadings are identified (identified in bold in Table 3.7). For example, PC1 (Principal Component 1) is correlated closely with the business environment factor variables labeled *g, h, i, j,* and *o*. These variables represent similar factors dealing with the costs of doing business and government rules and regulations, so PC1 is interpreted as describing "state business costs and regulations" (Table 3.8).

Continuing, PC2 is closely correlated with factor variables *l, q, r,* and *s*, and is interpreted as "cooperative marketing and technical assistance". PC3 loads strongly on factor variables *a, b, k, t, u, v,* and *w,* and is interpreted as "infrastructure and market access", while PC4 is closely correlated with factor variables *c, d, e, f,* and is interpreted as "state business incentive programs". Finally, PC5 is associated with factor variables *m*, *n*, and *p*, variables generally describing "workforce availability and development".

Average business factors scores were calculated by associated principal component, representing the relative benefit or harm of these more parsimonious categories to food and beverage manufacturing firms in NYS (Table 3.8). The principal components rated as most beneficial (i.e., the highest average scores) to firms are "cooperative marketing and technical assistance" (mean score = 3.65) and "infrastructure and market access" (mean score = 3.64), while "state business costs and regulations" is rated as the most harmful to business (mean score = 2.43). State business incentive programs and workforce availability and development are rated as being slightly beneficial to business, with mean scores of 3.25 and 3.20, respectively.

Table 3.8. Principal Components (PC) with Associated Variables and Interpretations

PC	Variable	Variable Description	PC Description	PC Mean
PC1	*g*	State-level costs of doing business	state business costs and regulations	2.43
	h	Other costs of doing business		
	i	State- and local-level governmental regulations and permitting		
	j	The cost of living for your employees		
	o	Labor force wage rates		
PC2	*l*	Quality of State college and university research and assistance	collaboration, mktg. and technical assistance	3.65
	q	State branding, promotional and marketing campaigns		
	r	Regional or local branding activities and efforts		
	s	Availability of alliances and collaborations with other firms		
PC3	*a*	Quality of transportation infrastructure	infrastructure and market access variables	3.64
	b	Quality of communication infrastructure		
	k	Your region's overall quality of life		
	t	Availability of trucking services		
	u	Availability of product distribution services		
	v	Proximity of customer markets		
	w	Proximity of input suppliers		
PC4	*c*	Level of State initiatives for business growth	state business incentive programs	3.25
	d	State support for improved environmental practices		
	e	State support for energy efficiency and renewables		
	f	Ability to enter into Public-Private partnerships		
PC5	*m*	Availability of workers with the skills your business requires	workforce availability and development	3.20
	n	Availability of management and other professional staff		
	p	Availability of workforce training opportunities		

These general results were to be expected. Previous research into food manufacturing firms has found that the performance of these firms is highly dependent on the ability to transport raw inputs from agricultural producers to the plant and transport the finished product from the plant to product markets (Goetz, 1997). Often this is because of the bulk size of agricultural inputs and the short shelf-life and special transportation concerns of food products. This is also reflected in previous surveys of agribusiness firms reflecting that market access and transportation are the most important factors affecting firm performance. For example, a survey of agribusiness firms in Illinois found that the most important factor in the growth or contraction of firms was the proximity to product markets (Vesecky and Lins, 1995). Lopez and Henderson (1989) also found proximity to markets to be the most important factor overall, followed by infrastructure and labor factors.

When the mean ratings of the five principal components are calculated by industry sector and firm size (Tables 3.9 and 3.10, respectively) several trends appear. As shown in Table 3.9, fruit and vegetable, alcoholic beverage, and maple processors appear to benefit the most from “cooperative marketing and technical assistance” (mean ratings of 3.71, 3.76, and 3.78, respectively). “Infrastructure and market access” is rated as most beneficial by seafood processors (mean rating = 3.92), who also have the lowest rating of state business incentive programs (mean rating = 2.98). “Workforce availability and development” is rated as most beneficial by other food processors and non-alcoholic beverage processors (respective mean ratings of 3.36 and 3.40), and rated the least beneficial by grain and oilseed millers (mean rating = 2.78).

Table 3.9. Average Principal Component Business Factor Scores, by Industry Sector

Principal Component	Industry Sector: All	Grain	Sugar	Fruit & Veg.	Dairy	Meat	Seafood	Bakery	Other	Non-Alc. Bev.	Alc. Bev.	Maple
cooperative marketing and technical assistance	3.65	3.17	3.39	3.71	3.56	3.34	3.36	3.36	3.49	3.28	3.76	3.78
infrastructure and market access	3.64	3.36	3.53	3.57	3.61	3.54	3.92	3.62	3.56	3.50	3.54	3.57
state business incentive programs	3.25	3.21	3.11	3.35	3.27	3.10	2.98	3.16	3.27	3.33	3.17	3.27
workforce availability and development	3.20	2.78	3.14	3.16	3.09	3.06	3.21	3.18	3.36	3.40	3.12	3.17
state business costs and regulations	2.43	2.37	2.39	2.59	2.74	2.20	2.40	2.54	2.43	2.72	2.34	2.62

From the ratings averaged over firm size (Table 3.10), it appears that non-employee firms benefit the most from “cooperative marketing and technical assistance” (mean rating = 3.63). Firms with over fifty employees view “infrastructure and market access”, “state business incentive programs”, and “workforce availability and development” as more beneficial than the other smaller-sized firms do. Finally, “state business costs and regulations” were rated as most harmful by mid-sized firms.

Table 3.10. Mean of Principal Component, by Employee Size

		Number of Employees			
Principal Component	All	None	1 to 9	10 to 50	> 50
cooperative marketing and technical assistance	3.65	3.63	3.57	3.52	3.56
infrastructure and market access	3.64	3.48	3.56	3.59	3.73
state business incentive programs	3.25	3.20	3.15	3.22	3.42
workforce availability and development	3.20	3.06	3.16	3.17	3.26
state business costs and regulations	2.43	2.62	2.48	2.35	2.57

Stated Examples of Effective Programs

Firms were asked to identify specific examples of “effective programs or initiatives in New York State that improve the competitiveness” of their business. As was evident from the factor analysis of business factor ratings, programs involving “cooperative marketing and technical assistance” were among the most stated examples of effective programs (e.g., Pride of New York, Wine and Maple Trade Associations, Cornell’s technical assistance programs). Also reported as effective were certain state business incentive programs such as loan, grant, and energy programs (Table 3.11).

Table 3.11. Programs Listed as Effective for Improving Competitiveness

Stated Program	Number of Plants
Pride of New York	52
Cornell	50
Wine Associations	34
Empire Zones	30
Maple Associations	21
Loan, grant, credit programs	17
Energy programs	16
Agriculture and Markets	9
Small business development	7
Farmers markets	6
Tourism	5

Source: 2009 NYS Food and Beverage Manufacturing Survey

The factors affecting firm performance will be further analyzed using the growth modeling in subsequent chapters. Based on the Principal Components Analysis it is expected that the performance of food and beverage manufacturing establishments in NYS will be highly dependent on plant location, and especially how location choice affects firm access to markets and transportation costs.

CHAPTER 4

MODEL DESCRIPTION

The objective of this study is to develop a better understanding of how the economic environment within New York State (NYS) affects the performance of food and beverage manufacturing firms. In order to better understand the relationship between firm performance and characteristics of areas in NYS, firm growth will be modeled as a function of various spatial variables to proxy for the local economic environment at the firm's location, while controlling for firm-level factors.

Conceptual Framework

Much of the previous research investigating the growth of rural manufacturing industries, and food manufacturers in particular, use aggregate time-series data of the number of manufacturing establishments (see Table 2.1, Chapter 2). These studies examine the change in the number of establishments at the county or state level as being determined by the spatial factors describing that county or state. This literature has generally adapted firm location theory given the investigation of spatial attributes that attract new establishments to certain areas.

While this study is investigating firm-level growth rather than firm location decisions, it conceptually relies on neoclassical firm location theory for two reasons. First, this study is examining growth primarily through spatial variables and the location theory model provides a framework for the inclusion of these variables. Second, the location theory model assumes that firms will locate in the most profitable location as determined by spatial factors. The profitability of a location based on the qualities of that location should therefore also influence the current growth rates of firms; e.g., increases in employment or output. Put another way, location theory conceptually determines areas where firms are most likely to locate and firms already located in these areas should correspondingly have higher rates of firm-level growth.

The neoclassical theory of firm location as specified by Deller (2008) is a two-stage process. During the first stage, a firm chooses a region to maximize profits based on transportation costs due to the location of input and output markets. During the second stage, a firm chooses an exact location within this region based on a variety of location-based factors. Following Deller (2008), consider a firm selling a single product in *m* output markets and charging a price P_i in each market ($i = 1, \ldots, m$). Each market has its own demand for the product $D_i(P_i)$, such that total firm revenue (R) can be expressed as:

(4.1) $R = \sum_{i=1}^{m} P_i D_i(P_i)$

The firm purchases production inputs x_i from market *i* ($i = 1, \ldots$, n) and faces a production function $q(\cdot)$ to produce firm output $q(x_i)$. Assuming constant marginal costs of producing one unit of output (v), the total cost of production (PC) is the fixed cost of production (f) plus variable cost of production ($vq(x_i)$), or:

(4.2) $PC = f + vq(x_i)$

Further, let $d(s, s^i)$ represent the cost of transporting one unit of input x_i from market location s^i to plant location s ($i = 1, \ldots, n$); and let $t(s, s^i)$ represent the cost of transporting one unit of output from plant location s to market location s^i. ($i = 1, \ldots, m$). Total transportation costs (TC) can then be represented as:

(4.3) $TC = \sum_{i=1}^{m} t(s, s^i) D_i(P_i) + \sum_{i=1}^{n} d(s, s^i) x_i$

Combining 4.1, 4.2, and 4.3, the general profit maximization problem of the firm can be defined as:

(4.4) $\Pi = \sum_{i=1}^{m} P_i D_i(P_i) - f - vq(x_i) - \sum_{i=1}^{m} t(s, s^i) D_i(P_i) - \sum_{i=1}^{n} d(s, s^i) x_i$

In the first-stage, the firm selects a set of prices (P_i) that maximize demand at each market and a location (s^*) that minimizes transportation costs. Note that the number of output markets (m) and input markets (n) need not be equal, nor be overlapping (i.e., a single market location represents both an output market and an input market); and that unit transportation costs may vary by distance and across types of products.

At this point, the firm has not necessarily made its final decision when identifying the transportation cost minimizing location s^*. Specifically, under the general theory of firm location above, we assumed a homogenous economic plane, but now the firm considers other economic variations across locations based on unique factor endowments. In the first step, the firm identifies a general location based on transportation costs; but once the transportation costs are minimized, the firm's attempt to minimize factor production costs may result in a new location (Deller, 2008).

As shown in Deller (2008), a useful way to visualize this process is through the use of spatial cost curves (i.e., isocosts), that spatially represent the total costs of production including transportation, land, labor, and capital costs. Consider Figure 4.1, where s^* represents the minimum-transportation cost location from the firm's problem above, s^1, s^2, and s^3 represent input and/or output markets, and c^1 and c^2 represent isocost curves where the cost to the firm is identical at each site along a particular isocost curve. Now, because of variations in labor, land, and capital markets, there may be a specific location on a particular isocost curve that has lower overall costs to the firm than at s^* (Deller, 2008).

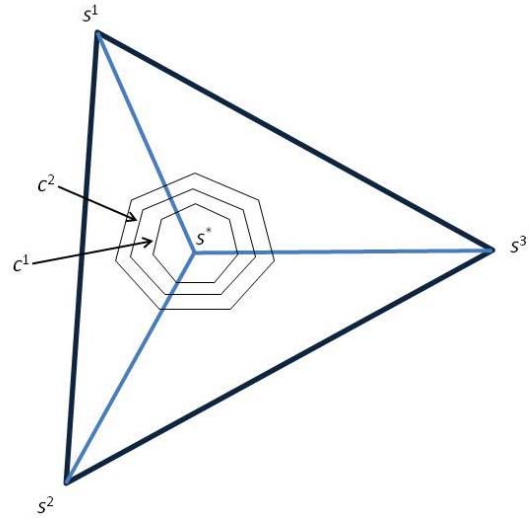

Figure 4.1. Profit Maximizing Isocost Curves in the Firm's Location Decision
Source: Deller (2008)

During the second stage of the location process, the firm chooses locations within the regional location where transport costs are assumed to be a constant c or:

(4.5) $TC = \sum_{i=1}^{m} t(s^*, s^i) D_i(P_i) + \sum_{i=1}^{n} d(s^*, s^i) x_i = c$

In this stage, production costs vary within the regional location s^* based on the factor endowments in each specific location u, or:

(4.6) $PC = f(u) + v(u) q(x_i, u)$.

Firms now choose a specific location u^* which maximizes the revised profit equation incorporating spatially differentiated variable and fixed factor costs of production, or:

(4.7) $\Pi = \sum_{i=1}^{m} P_i D_i(P_i) - f(u) - v(u) q(x_i, u) - c$

In the context of this study, a firm would first have intended product markets and input markets and would choose a region in NYS near these markets to minimize transport costs. For example, a grain miller whose primary transport costs are incurred from shipping raw materials would likely choose a region in upstate New York with many grain producers. However, a bakery that uses final products from grain millers as inputs and sells its own final products to numerous retail establishments in New York City would likely choose the downstate region to minimize product distribution costs.

In our (data driven) context, during the second stage of the selection process, the firm would choose a county within the region selected in the first stage. Transportation costs would be nearly constant between counties in this region, but other county-level cost factors such as infrastructure, skilled labor, market access, and local labor supply would differ.

Empirical Model

Empirically, we wish to examine the difference in growth between NYS food and beverage manufacturing firms, with the reasonable assumption that growth is entirely dependent on firm profitability. Then, after controlling for regions, industry categories, and firm-level characteristics, the profitability and growth of the firm should be dependent on location-specific cost and revenue factors. Specifically consider:

(4.8) $Growth = f\left(x_{firm},\ x_{labor}, x_{upstream}, x_{within-stream}, x_{downstream}\right)$

where x_{firm} is a vector of firm-specific growth factors, x_{labor} is a vector of local labor market factors, $x_{upstream}$ is a vector of local input market factors, $x_{downstream}$ is a vector of local output market factors, and $x_{within-stream}$ is a variable describing the degree of clustering of similar firms (i.e., impact of firm agglomeration economies).

Given the different production and processing characteristics of maple and alcoholic beverage industries relative to more traditional ‘bricks and mortar’ operations, including all observations from the plant-level survey may be problematic and skew the results. Many maple producers in the survey expressed that they produced maple products only as a hobby. As many of these maple producers might not be operating in the manner of a profit-maximizing firm, these results may not follow the theoretical basis of growth as previously described. However, most alcoholic beverage manufacturers in the study are wineries and are expected to operate under profit maximizing behavior. While there is concern that wineries as well as maple producers lack the ability to change location that other food and beverage manufacturers may have, this can be accounted for largely through the use of industry specific fixed effects. As a result, the models that follow include one for all industries except maple producers and a supplementary model for maple producers.

Firm Growth

The variables included in the empirical model are summarized in Table 4.1. To capture firm profitability, the dependent variable in this model is average annual revenue growth for the past three years (*RGROWTH*). The survey asked respondents to estimate the average revenue growth during the past three years and respond in terms of nine categories: over -20%, -11% to -20%, -5% to -10%, -1% to -4%, 0%, 1% to 4%, 5% to 10%, 11% to 20%, and over 20% (see Figure 22, Chapter 3). While the responses are categorical, given the number of categories, *RGROWTH* is treated as a continuous variable by assigning category midpoint values. If the respondent answered over -20% or over 20% growth, -20 or 20 were correspondingly assigned for *RGROWTH.*

Table 4.1. Variable Descriptions, Non-Maple Model (N=348)

Variable	Level	Description	Source	Mean	Std. Dev.	Min	Max
Dependent variable:							
RGROWTH	Firm	Average annual revenue growth, past three years	survey	5.01	10.23	-20.00	20.00
firm-level variables:							
YEARS	Firm	Number of years plant has been operating	survey	29.34	30.77	1.00	212.00
EMPL	Firm	Number of full- and part-time employees	survey	3.51	1.75	1.00	8.00
Cluster variables:							
FBPCNT	County	Percent of establishments in food and beverage manufacturing (NAICS = 3112-3119, 3121)	U.S. Census 2009a	0.59	0.56	0.10	2.63
AGVALUE	County	Cash value of crops and livestock per 100,000 people	USDA 2009, U.S. Census 2009a	0.75	0.98	0.00	5.52
DOWNPCNT	County	Number of establishments per capita in wholesale, retail, and service food and beverage (NAICS = 424, 445, 722)	U.S. Census 2009a, 2009b	6.06	16.04	0.55	219.21
URBAN	County	Urban county = 1 if at least 80% of households located in an urbanized area, else 0	U.S. Census 2009b	0.42	0.49	0.00	1.00
Population variables:							
PDEN	County	Population per square mile	U.S. Census 2009b	5.12	12.04	0.02	52.42
PGROW	County	Percent change in population from April 2000 to July 2008	U.S. Census 2009b	1.26	3.72	-5.08	11.21
Labor variables:							
MWAGE	County	Average annual pay for manufacturing employees ($1000)	U.S. Bureau of Labor Statistics, 2008	51.37	14.48	28.75	97.38
HSGRAD	County	Percent of adults 25 and older with at least a high school degree	U.S. Census 2009b	0.81	0.05	0.62	0.91

Source: NYS Food and Beverage Manufacturing Survey

Table 4.1. Variable Descriptions, Non-Maple Model (N=348) continued

Variable	Level	Description	Source	Mean	Std. Dev.	Min	Max
Industry fixed effects:							
SUGAR	Firm	Sugar and confectionary product manufacturing (NAICS 3113)	survey	0.05	0.22	0.00	1.00
FRTVEG	Firm	Fruit and vegetable preserving and specialty food manufacturing (NAICS 3114)	survey	0.11	0.32	0.00	1.00
DAIRY	Firm	Dairy product manufacturing (NAICS 3115)	survey	0.10	0.30	0.00	1.00
MEAT	Firm	Animal slaughtering and processing (NAICS	survey	0.14	0.35	0.00	1.00
BKRY	Firm	Bakeries and tortilla manufacturing (NAICS 3118)	survey	0.17	0.37	0.00	1.00
ABEV	Firm	Alcoholic beverage manufacturing (NAICS 31212-31214)	survey	0.21	0.41	0.00	1.00
OTHER	Firm	Grain and oilseed milling (NAICS 3112), seafood processing (NAICS 3117), non-alcoholic beverage manufacturing (NAICS 31211), other food manufacturing (NAICS 3119)	survey	0.22	0.41	0.00	1.00
Regional fixed effects:							
CAPREG	Firm	Capital region	survey	0.08	0.28	0.00	1.00
CENREG	Firm	Central region	survey	0.06	0.24	0.00	1.00
FLREG	Firm	Finger Lakes region	survey	0.18	0.39	0.00	1.00
LIREG	Firm	Long Island region	survey	0.09	0.28	0.00	1.00
MHREG	Firm	Mid-Hudson region	survey	0.15	0.35	0.00	1.00
MVREG	Firm	Mohawk Valley region	survey	0.05	0.22	0.00	1.00
NYCREG	Firm	New York City region	survey	0.15	0.35	0.00	1.00
NORTHREG	Firm	North Country region	survey	0.04	0.19	0.00	1.00
SOUTHREG	Firm	Southern Tier region	survey	0.09	0.29	0.00	1.00
WESTREG	Firm	Western region	survey	0.11	0.32	0.00	1.00
2SLS instrumental variables							
MANUF1920	County	1920 manufacturing production per capita	U.S. Census, 2004	0.62	0.37	0.08	1.54
POPLN1920	County	1920 population per square mile	U.S. Census, 2004	53663.66	189161.10	174.00	1038229.00

Source: NYS Food and Beverage Manufacturing Survey

Firm-Level Factors

The variables *YEARS* and *EMPLOYEES* are the firm-level variables included in the model to capture the effect of experience and firm size, respectively. *YEARS* is the number of years the plant has been operating in NYS, while *EMPLOYEE*S is the average number of full- and part-time employees. It has been shown that smaller and younger firms tend to grow at a more rapid pace (Heshmati, 2001, Davidsson et al, 2000). It is typically thought that a firm will have a size at which profits are maximized given the size of the market for its product and the operating conditions of the firm. Small businesses can grow very rapidly in their early stages and, as they approach this profit-maximizing size, growth declines until eventually growth stops when the firm reaches the profit-maximizing size. So it is expected that years and employees will both have a negative effect on revenue growth.

It is expected that the industry sector in which a plant operates will have an effect on the revenue growth of the plant. The business environment in NYS is not static. Over time changes in a variety of factors influencing firm profitability (e.g., changes in input costs, consumer demand preferences, foreign competition, etc.) will affect some food and beverage manufacturing sub-industries more than others. We would thus expect to see differences in revenue growth across industry sectors. *A priori*, there is little theory to guide our expectations in terms of which sectors will grow and which will decline. However, descriptive analysis of the survey data (Chapter 3) indicated that growth expectations (capital, staffing, revenue) were highest for alcoholic beverage processors and other food processors.

To control for these specific industry effects, industry dummies were included in the empirical model. Since grain and oilseed milling (NAICS 3112), seafood processing (NAICS 3117), and non-alcoholic beverage manufacturers (NAICS 31211) all had a limited number of observations (less than 12 in total), they were included in the *OTHER* category along with other food manufacturers (NAICS 3119). After this revision, the non-maple sample of plants had seven industry categories, *OTHER* and *ABEV* being the largest, with 76 and 74 observations respectively (Figure 4.2).

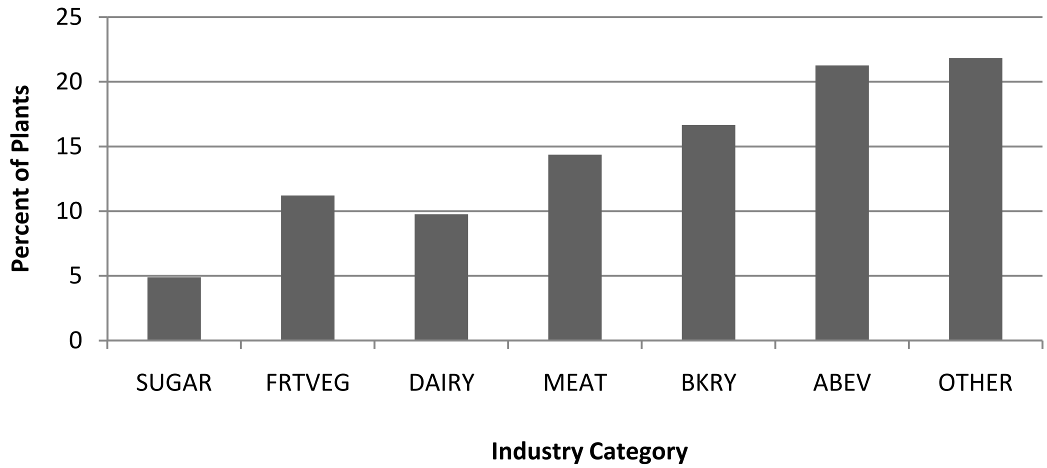

Figure 4.2. Non-Maple Growth Model Observations, by Revised Industry Categories (N=348)
Source: 2009 NYS Food and Beverage Manufacturing Survey

Firm Clustering

In this study, we wished to examine the effect of locating within a cluster, not only a cluster of firms of the same industry (i.e., food and beverage manufacturing), but also possible clusters of upstream (input suppliers) and downstream (wholesale, retail or foodservice buyers) firms. As described by Henderson and McNamara (2000), food manufacturers can be classified into three categories depending on the relative cost structure of the firm: (1) supply oriented firms which locate near agricultural inputs, (2) demand oriented firms which locate near output markets, (3) footloose firms whose location decisions rely on other factors of production than market location. To model these effects, we will extend the notion of clustering to describe three types of clusters: upstream clusters, within-stream clusters, and downstream clusters. These will be proxies to measure the concentration of upstream agricultural production, within-stream food and beverage processors, and downstream markets, respectively.

To identify clustering and to estimate agglomeration effects in manufacturing firms, the percent of workers employed in the manufacturing or a defined subset of manufacturers is commonly used (Asiseh et al., 2009; Davis and Schluter, 2005; Gabe, 2005; Rainey and McNamara, 1999) as the level of employment is generally considered a good measure of the size of the industry, and policymakers are typically interested in job creation. However, results from this survey indicated that many of the food and beverage manufacturing firms have only a few or no employees. As a result, to create the within-stream cluster variable, the percent of all establishments in food and beverage manufacturing, *FBPCNT*, rather than the percent of employment, was used to indicate the extent of food and beverage manufacturing clustering. This measure of within-stream firm clustering shows a comparatively high concentration of food and beverage manufacturing in the western half of the state, especially in the Finger Lakes Region (Figure 4.3). Amongst the downstate counties, New York County and Bronx County have the highest concentration of food and beverage manufacturers.

Given that food and beverage processing occurs in both rural and urban areas of the state, we allow for within-stream cluster effects to vary across these two dimensions. Production factors and availability of markets differ significantly between urban and rural areas. Firms located in urban areas likely have different cost structures than firms located in rural areas and, therefore, may have differential benefits from clustering. Additionally, smaller populations in rural counties may make rural processors more sensitive to competition effects from other processors in the area. To measure this, counties with over 80% of households located in urbanized areas were identified as ‘urban counties’ (Figure 4.4) and a dummy variable (*URBAN*) was created to indicate whether the plant is located in an urban county.

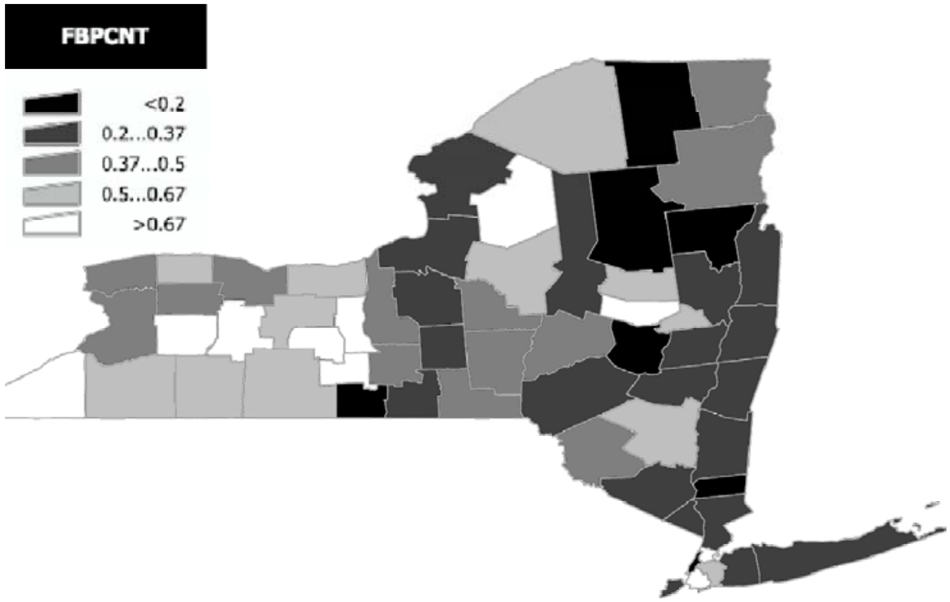

Figure 4.3. Level of Within-Stream Firm Clustering, by County (Percent)
Source: US Census Bureau, 2009a, 2009b
Note: *FBPCNT* = 100 × Number of Food and Beverage Manufacturing Establishments / Total Establishments in All Industries

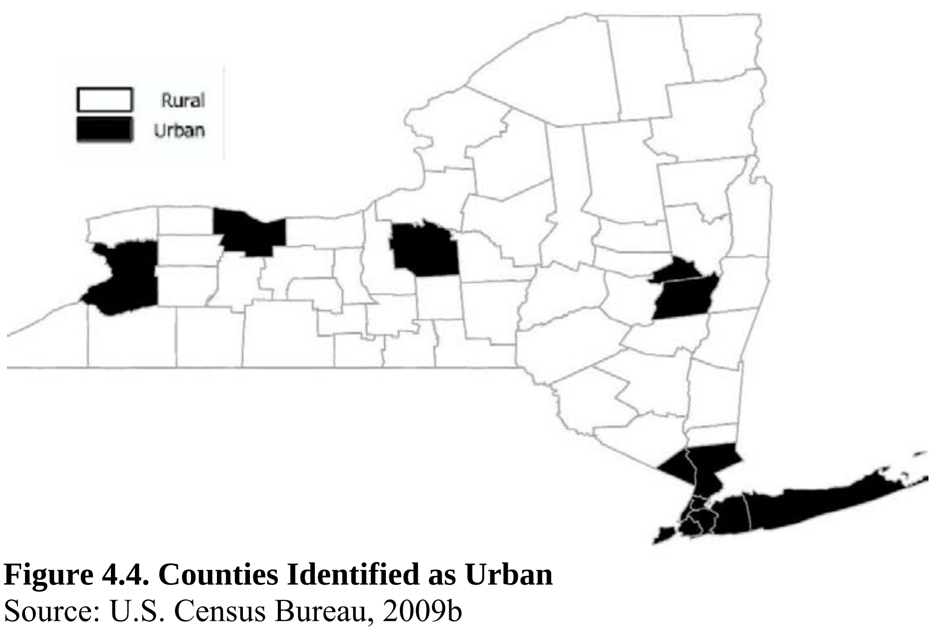

Figure 4.4. Counties Identified as Urban
Source: U.S. Census Bureau, 2009b
Note: County defined as urban if at least 80% of households are urban households

Of the 62 counties in NYS, 13 were identified as urban counties by this measure, with 146 observations from these urban counties and 202 from rural counties. To examine the differences between plant clustering effects in urban and rural areas, *URBAN* was interacted with *FBPCNT*.

The variable *AGVALUE* was used as an indicator of upstream clustering (Figure 4.5). Rather than farm counts, *AGVALUE* is the value of agricultural crops and livestock sold in 2007 per 100,000 people on a county-level basis, and is intended to measure the concentration of agricultural production in the area. The counties within the Finger Lakes Region had some of the highest concentrations of agricultural production. The North Country Region had a high level of agricultural production as well. As would be expected, upstream firm clustering, as measured by *AGVALUE*, was lowest in or near urban counties. Henderson and McNamara (2000), Davis and Schluter (2005), Asiseh et al (2009), and Goetz (1997) found county agricultural production to have a positive effect on the growth of food manufacturers. Goetz (1997) notes that although this measure is a proxy for the availability of raw materials, it also indicates the degree of rurality of the firm's location and the distance from output markets.

Finally, to model the effects of downstream clustering (a local concentration of buyer firms) the county-level number of establishments in: (1) merchant wholesalers, nondurable goods[1], (2) food and beverage stores (3) food services and drinking places was estimated on a county per-capita basis (*DOWNPCNT*). It is hypothesized that downstream clustering should have a positive effect on the growth of food and beverage manufacturers as a demand-pull component of firm growth, although this measure has not been used in previous studies. Within NYS, *DOWNPCNT* appears to

[1] Food wholesalers and beverage wholesalers are a substantial portion of this category. Due to the limits of available data, we were unable to use data for solely the sub-categories involving food and beverage wholesale.

be greatest in certain counties near metropolitan areas, but low within these counties containing metropolitan areas themselves (Figure 4.6).

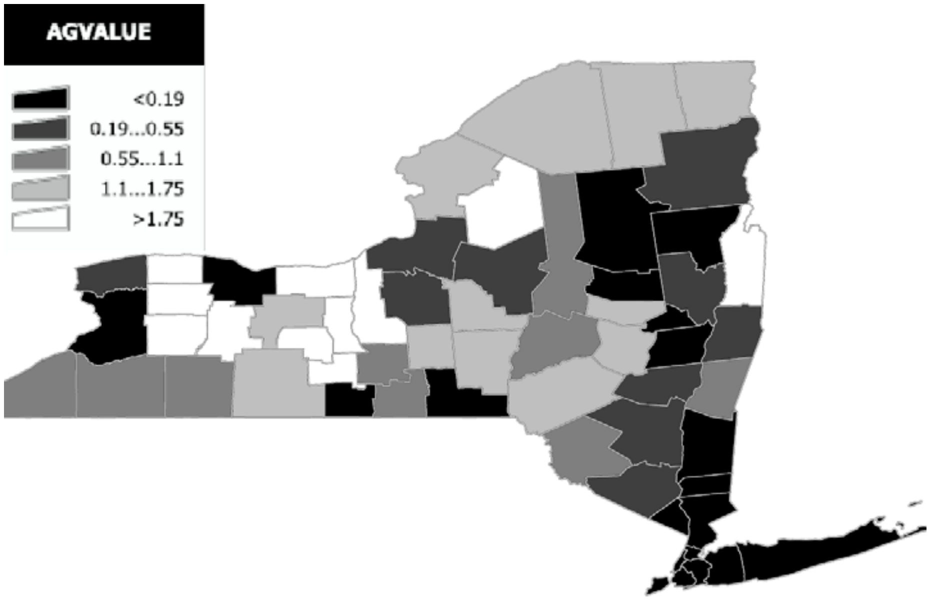

Figure 4.5. Level of Upstream Firm Clustering, by County
Source: USDA, 2009; U.S. Census Bureau, 2009b
Note: *AGVALUE* = Value of Crops and Livestock / 100,000 residents

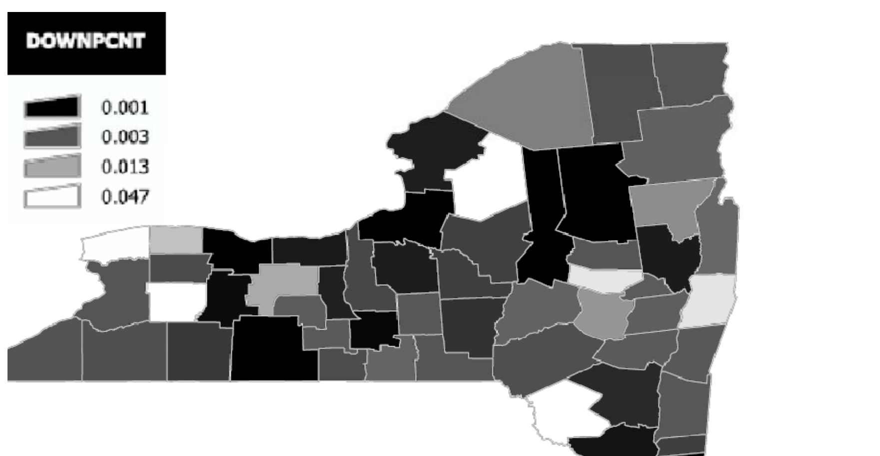

Figure 4.6. Level of Downstream Firm Clustering, by County
Source: U.S. Census Bureau, 2009a
Note: *DOWNPCNT* = (Number of Establishments in NAICS 424, 445, and 722) / population

The absolute number of downstream firms per county is highly correlated with population; counties with the largest populations have the largest number of downstream establishments. The effect of downstream clusters may be better captured using the absolute number of establishments, rather than the per-capita number of establishments, but the stated correlation between the absolute number of establishments and the population variables caused multicollinearity problems when this measure was used in the model. Additionally, as 38% of plant sales from our sample, on average, go directly to consumers, downstream effects may also be captured by differences in consumer populations. To address this, we also include variables representing population density (*PDEN*) and population growth rate (*PGROWTH*), (Figures 4.7 and 4.8, respectively).

Spatial-Market Factors

As would be expected population density is greatest in the downstate region and in the urban counties within upstate New York. Population declined between 2000 and 2008 within the Western New York Region. Downstate counties had some of the highest rates of population growth, along with several counties near Albany and the Finger Lakes region. Rainey and Murova (2002) found population density to have a positive effect on the growth in number of total manufacturing establishments. Likewise, population growth is expected to have a positive effect on firm growth.

Attributes of the local labor supply are proxied by the county-level variables average manufacturing wage (*MWAGE*) and the percentage of the population with at least a high school degree (*HSGRAD*), Figures 4.9 and 4.10 respectively. Both average manufacturing wage and the percent of the population with at least a high school diploma are high in counties surrounding New York City, but low in the New York City boroughs themselves. Both measures also appear to be high in the Capital

Region surrounding Albany and in counties containing the cities of Rochester, Buffalo, and Syracuse.

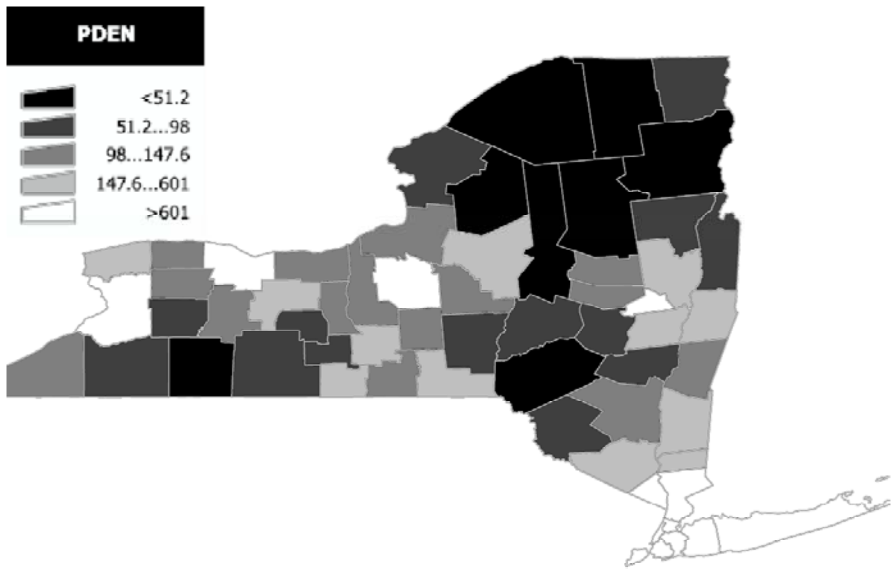

Figure 4.7. Population Density, by County
Source: U.S. Census Bureau, 2009b
Note: *PDEN* = Population / Land Area (miles^2)

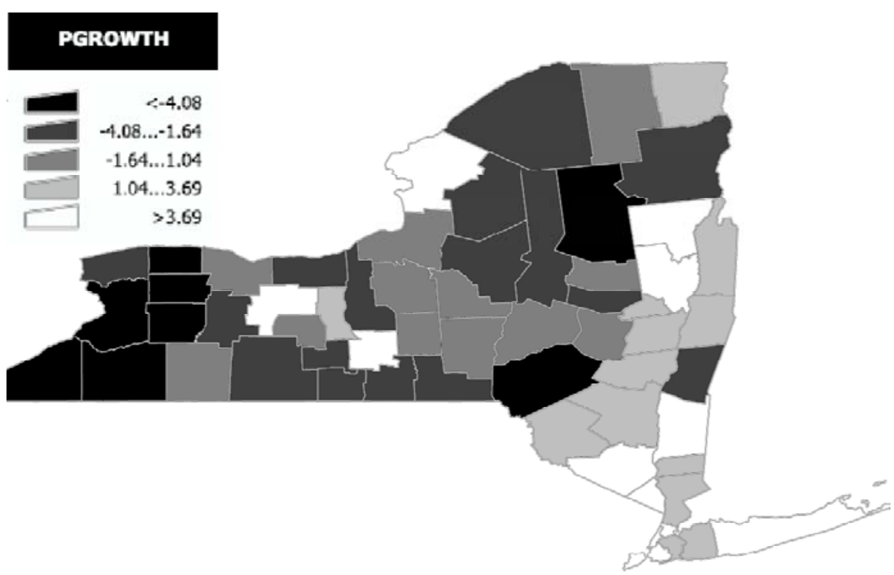

Figure 4.8. Population Growth Rate (Percent), by County
Source: U.S. Census Bureau, 2009b
Note: *PGROWTH* = 100 × (2008 population - 2000 population) / 2000 population

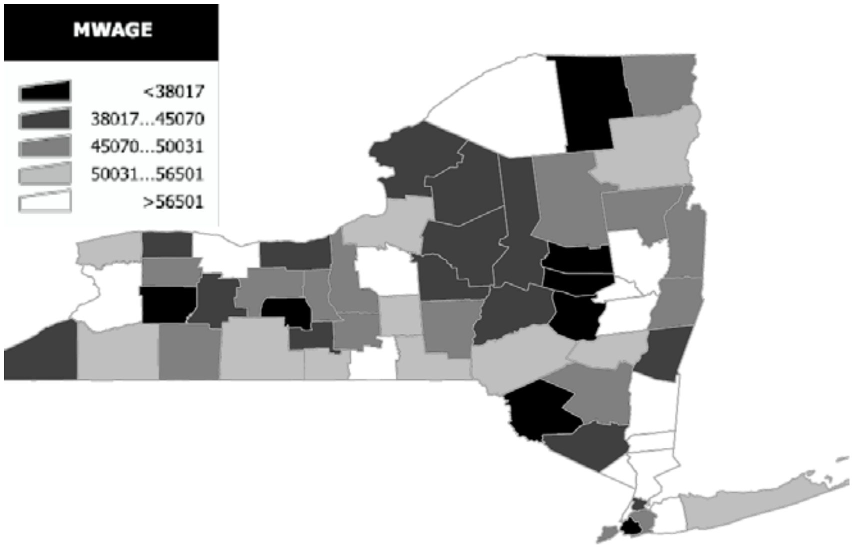

Figure 4.9. Average Annual Manufacturing Wage, by County
Source: U.S. Bureau of Labor Statistics, 2008
Note: *MWAGE* = Annual Wages for NAICS 31

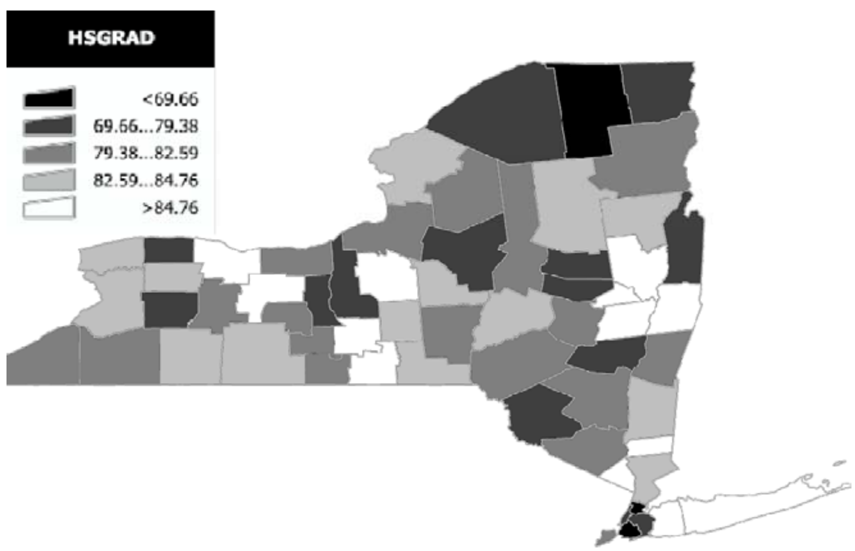

Figure 4.10. Percent of Adults with at Least a High School Diploma, by County
Source: U.S. Census Bureau, 2009b

It is assumed that food and beverage manufacturing firms' wage rates will be influenced, in part, by the local wage rates for all manufacturing employees. Locating a firm in a county where local manufacturing wages are relatively high compared to other counties will comparatively increase production costs for these firms. Therefore, it is hypothesized that firms located in counties with lower wage rates, all other variables being equal, will be more profitable and have higher rates of growth.

Goetz (1997), and Henderson and McNamara (2000) found county manufacturing wage rates to have a negative effect on food manufacturing investment. Rainey and McNamara (1999) found the same negative effect of county wage rates on the location decisions of aggregate manufacturing establishments. However, Brown, Florax, and McNamara (2008) found higher wages resulted in increased investment in total manufacturing. This result was unexpected and the authors suggested that wages might have been an indicator of the education and skill level of the local labor pool, which was not controlled for. In this model, education will be controlled for using *HSGRAD*, so it is expected that *MWAGE* will in turn have a negative effect on firm growth. Also, since wineries require substantial seasonal labor for harvest, unlike other manufacturers in the sample, an industry-wage rate interaction term was included with the winery sector fixed effect.

Goetz (1997), Rainey and Murova (2004), and Asiseh et al (2009) used the percent of adults with a high school diploma (*HSGRAD*) as an indicator of the education level of the local labor supply. Goetz (1997) found this measure of education had a positive effect on the number of food manufacturers in the county; and Rainey and Murova (2004) found a positive effect on the number of all manufacturers in the county. Based on these results, *HSGRAD* is expected to have a positive effect on *RGROWTH* in our model.

Additionally, there are substantial differences in the structure of regional economies within New York State. For example, the economy of the New York City metropolitan region is largely composed of financial and other services, while regions surrounding Buffalo and Syracuse are more dependent on manufacturing, and rural regions such as the North Country and Southern Tier are primarily dependent on agriculture. As such, events in the national and international economy will affect these regional economies in different ways. To control for additional regional differences, dummy variables were created for the regions of New York as defined by the Empire State Development Corporation (Figures 4.11 and 4.12). The Finger Lakes, Mid-Hudson, and New York City Regions contained the largest number of non-maple responding plants.

Figure 4.11. New York State Regions
Source: Empire State Development Corporation

Previous studies have suggested that tax rates and available infrastructure will affect firm costs (Lambert, McNamara, and Beeler, 2007; Goetz, 1997). However, for our purposes, much of the taxes and other governmental costs of operating in NYS are state-level costs and thus do not vary between counties. NYS also has numerous programs to offset governmental costs for selected firms, which makes accurate measures of county differences in governmental costs infeasible from available data sources.

There is so much variation in government costs for individual firms within each county that any measure of county average costs would not be indicative of true costs to an ordinary firm. Likewise, within the state, nearly all counties provide access to highways, the typical proxy for infrastructure. As such, these two spatial cost factors were not considered.

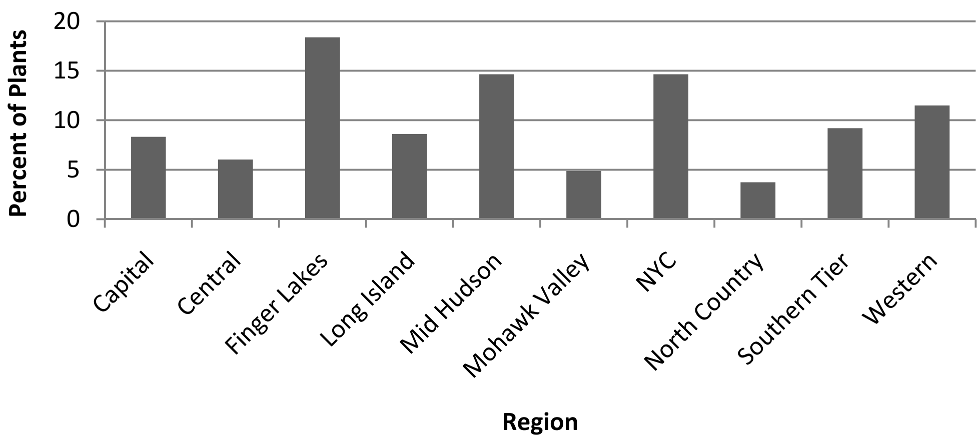

Figure 4.12. Percent of Non-Maple Plants Located by Region (N=348)
Source: 2009 NYS Food and Beverage Manufacturing Survey

Model Specification

The final empirical model for non-maple plants is thus specified as:

(4.9) $RGROWTH_i = \beta_0 + \beta_1 * YEARS_i + \beta_2 * EMPLOYEE_i + \beta_3 * MWAGE_{i,j} + \beta_4 * PGROW_{i,j} + \beta_5 * PDEN_{i,j} + \beta_6 * HSGRAD_{i,j} + \beta_7 * FBPCNT_{i,j} + \beta_8 * FBPCNT_{i,j} * URBAN_{i,j} + \beta_9 * AGVALUE_{i,j} + \beta_{10} * DOWNPCNT_{i,j} + \sum_{k=1}^{K-1} \gamma_k * INDUSTRY_{i,k} + \sum_{k=1}^{K-1} \alpha_k * INDUSTRY_{i,k} * MWAGE_{i,j} + \sum_{r=1}^{R-1} \delta_r * REGION_{i,r} + \varepsilon_i$

where *i* indicates the plant, *j* indicates county location, *k* indicates industry sector, and *r* indicates region. The β's, γ's, α's, and δ's are parameters to be estimated, and ε is the residual term distributed $\varepsilon \sim N(0, \sigma)$.

As discussed by Graham and Kim (2008), the within-stream cluster variable, *FBPCNT*, may be endogenous. Specifically, the concept of agglomeration economies predicts that the clustering of firms may provide beneficial effects to firms (examples are discussed further in Chapter 2). In our estimates we would thus expect increased firm concentration (as measured by *FBPCNT*) to cause an increase in firm performance (as measured by *RGROWTH*). However, there may instead be some spatial factor unique to a specific area which we are unable to account for in our modeling. Suppose this factor then caused increased revenues for nearby firms and attracted firms to the area thus increasing firm concentration. In this case, *RGROWTH* and *FBPCNT* would be jointly determined, causing Ordinary Least Squares (OLS) estimates of the model to be inconsistent (Greene, 2003).

To address this issue, the empirical model was also estimated using a two-stage least squares (2SLS) approach, similar to Jaenicke et al (2009). The 2SLS procedure uses instrumental variables (Z) to estimate the endogenous variable (x) in the first stage of the procedure, forming an estimated variable ($\hat{x}$). Z are chosen to be uncorrelated with the initial dependent variable (y), so that $\hat{x}$ is then exogenous. Then, during the second stage, the original equation is estimated with $\hat{x}$ replacing x.

While Jaenicke et al (2009) used additionally survey questions as instruments to predict the cluster variable during the first stage, we use historical census data similar to Rice, Venables, and Patacchini (2006). Population and manufacturing area data from the 1920 US Census should be an adequate indicator of current population and manufacturing areas, but should not be correlated with the performance of modern firms. Therefore, the county value of manufacturing production per capita (*MANUF1920*) and county population per square mile (*POPLN1920*) from the 1920 census were used as instruments to predict FBPCNT along with the county level measures in (4.9).

The first stage of the 2SLS procedure is therefore modeled as:

(4.10) $FBPCNT_j = \beta_0 + \beta_1 MANUF1920_j + \beta_2 POPLN1920_j + \beta_3 MWAGE_j + \beta_4 PDEN_j + \beta_5 PGROWTH_j + \beta_6 HSGRAD_j + \beta_5 AGVALUE_j + \beta_6 DOWNPCNT_j + \varepsilon_j$

where *j* indicates county. The β's are parameters to be estimated, and ε is the residual term distributed $\varepsilon \sim N(0, \sigma)$.

For the second stage of the 2SLS procedure, predicted values of *FBPCNT* are then used to estimate (4.9).

Maple Model

As discussed earlier, a growth model similar to (4.9) was estimated separately for the responding maple producers. Descriptive statistics for the sample of 71 observations are included in Table 4.2. Maple processing revenue growth (*RGROWTH*) is assumed to be dependent on upstream, within-stream, and downstream agglomeration variables *AGVALUE*, *FBPCNT*, and *DOWNPCNT2*[2]. Due to the fact that nearly all maple observations were located in rural counties, the *FBPCNT* was not interacted with *URBAN*. However, population effects were accounted for using county population density (*PDEN*) and county population growth rate (*PGROWTH*) variables. The firm-level variables *YEARS* and *EMPLOYEES* were also included based on the same rationale used in the non-maple model.

In model (4.9) the variables *MWAGE* and *HSGRAD* were used as proxies to capture effects of the local labor supply. Maple producers typically did not hire additional employees outside of the owner/operators, as responding maple producers reported having an average of 1.4 full- or part-time employees. Due to this, these labor market proxies were excluded.

[2] The downstream clustering variables in the maple model and non-maple model are different (Tables 4.1 and 4.2 define *DOWNSTREAM* and *DOWNSTREAM2)*. Each downstream variable produces improved statistical performance in its respective model, and proxy for the same effect.

Table 4.2. Variable Descriptions, Maple Model (N=71)

Variable	Level	Description	Source	Mean	Std. Dev.	Min	Max
dependent variable							
RGROWTH	Firm	average revenue growth over past three years	survey	4.68	9.73	-20.00	20.00
firm-level variables							
SALESUS	Firm	% of sales to US outside NYS	survey	12.21	22.82	0.00	90.00
YEARS	Firm	number of years plant has been operating	survey	25.58	22.48	2.00	100.00
EMPL	Firm	number of full- and part-time employees employed by plant	survey	1.51	0.53	1.00	3.00
clustering variables							
FBPCNT	County	county percent of firms in naics categories 3112, 3113, 3114, 3115, 3116, 3117, 3118, 3119, 3121	U.S. Census, 2009a	0.71	0.59	0.04	2.47
AGVALUE	County	county cash value of crops and livestock per 100,000 people	USDA 2009, U.S. Census 2009a	1.71	1.64	0.00	5.52
DOWNPCNT2	County	county percent of workers employed in naics categories 4244, 4245, 4248, 445, 722	U.S. Census, 2009a	11.52	1.11	9.00	13.46
population variables							
PDEN	County	county population per square mile	U.S. Census, 2009b	0.15	0.19	0.02	1.08
PGROW	County	county percent change in population from April 2000 to July 2008	U.S. Census, 2009b	-1.30	2.63	-5.08	4.80
INCOME	County	average county wages per worker	U.S. Census, 2009a	34.64	2.97	28.05	43.70
regional fixed effects							
CENREG	Firm	Central Region	survey	0.11	0.32	0.00	1.00
FLREG	Firm	Finger Lakes Region	survey	0.21	0.41	0.00	1.00
NORTHREG	Firm	North Country Region	survey	0.15	0.36	0.00	1.00
SOUTHREG	Firm	Southern Tier Region	survey	0.18	0.39	0.00	1.00
WESTREG	Firm	Western Region	survey	0.14	0.35	0.00	1.00
OTHER REG	Firm	Capital, Long Island, Mid Hudson, Mohawk Valley, NYC Regions	survey	0.20	0.40	0.00	1.00

Source: NYS Food and Beverage Manufacturing Survey

Overall, the returned surveys from maple producers had fewer unanswered questions and allowing for the consideration of including additional firm-specific variables from the survey. *SALEUS* is the reported percentage of sales which go to states within the U.S. but outside NYS. It is expected that if a maple producer has a large percentage of its sales going out of state this may be indicative of a large product distribution network

It is also expected that the cost of maple production is highly dependent on the cost of land; i.e., in an area where land values were relatively high, maple trees could be removed to convert the land to a more profitable use. To proxy for this, per-capita income (*INCOME*) (computed as total county wages divided by total county number of workers) was included and along with *PDEN* should provide some indication of the value of local land. Areas with high concentrations of population or areas with relatively wealthy populations will likely have more expensive land, negatively affecting the growth of maple processing operations.

The model was estimated with and without controlling for regional differences. Due to the fact that the majority of maple producers were in the upstate regions, five regions in or near the downstate area were combined (see Table 4.2). The empirical model for maple producers was thus defined as:

(4.11) $RGROWTH_i = \beta_0 + \beta_1 * YEARS_i + \beta_2 * EMPLOYEE_i + \beta_3 * SALESUS_i + \beta_4 * PGROW_{i,j} + \beta_5 * PDEN_{i,j} + \beta_6 * FBPCNT_{i,j} + \beta_7 * AGVALUE_{i,j} + \beta_8 * DOWNPCNT2_{i,j} + \beta_9 * INCOME_{i,j} + \sum_{r=1}^{R-1} \delta_r * REGION_{i,r} + \varepsilon_i$

where *i* indicates the observation, *j* indicates county, and *r* indicates region. The β's and δ's are parameters to be estimated, and ε is the residual term distributed $\varepsilon \sim N(0, \sigma)$.

CHAPTER 5

EMPIRICAL RESULTS

The econometric results of the empirical models for non-maple observations are shown in Table 5.1 (pages 93 and 94). As explained in Chapter 4, to account for potential endogeneity in the within-stream agglomeration variable (*FBPCNT*), the empirical models (excluding maple) were estimated using both Ordinary Least Squares (OLS) and two-stage least squares (2SLS) estimators. Then, endogeneity with respect to *FBPCNT* was tested for statistically. Table 5.1 provides the OLS (*FBPCNT* assumed exogenous) results in Models 1 and 2, and the 2SLS results in Models 3 and 4, both with and without controlling for regional fixed effects.

As can be seen by comparison, the empirical results from the OLS and 2SLS models are very similar. For variables with any minor level of significance (*t*-stats ≥ 1), the estimated coefficients change only modestly. Further, statistical significance is generally lower with the 2SLS model. Importantly, with our particular interest in potential agglomeration effects, the variables *FBPCNT* and *AGVALUE* are statistically significant only in the OLS models. Finally, the inclusion of regional dummy variables appears to have little effect on the estimates of the models. This result is not completely unexpected as regional differences were also accounted for, in part, with county-level spatial variables (e.g., *PDEN*, *PGROW*, and *MWAGE*).

The explained variation in *RGROWTH* (R^2 values) are relatively modest (around 0.11), but this was not entirely surprising as there are a wide variety of firm-specific factors (e.g., management strategy, skills, and experience) and location-specific business factors (e.g., business tax credits, abatements, or subsidies) that can be important to firm growth but was not available. As described in Chapter 2, individual characteristics of the owner and specific growth objectives of the firm can also affect growth rates experienced by the firm.

Table 5.1. Estimation Results for Annual Revenue Growth Models (N=348).

	OLS[A]		2SLS[B]	
	Model 1	Model 2	Model 3	Model 4
Firm-level variables				
YEARS	-0.036 *	-0.036 *	-0.038 *	-0.036 *
	(0.02)	(0.02)	(0.02)	(0.02)
EMPL	0.634 *	0.591 *	0.690 *	0.645 *
	(0.34)	(0.35)	(0.34)	(0.37)
SUGAR	-5.225 *	-4.655 *	-5.329 *	-4.819
	(2.71)	(2.77)	(2.71)	(3.01)
FRTVEG	-3.123	-3.635 *	-2.961	-3.331
	(1.98)	(2.03)	(1.99)	(2.19)
DAIRY	-1.391	-1.865	-0.996	-1.676
	(2.17)	(2.23)	(2.14)	(2.38)
MEAT	-3.933 **	-4.353 **	-3.834 **	-4.444 **
	(1.84)	(1.86)	(1.84)	(2.02)
BKRY	-2.866 *	-2.861	-2.870	-2.804
	(1.74)	(1.78)	(1.74)	(1.92)
ABEV	14.169 ***	12.652 **	12.890 **	11.285 **
	(5.21)	(5.34)	(5.20)	(5.72)
Labor variables				
HSGRAD	-11.824	-15.390	-14.429	-22.610
	(16.84)	(24.65)	(18.36)	(26.50)
MWAGE	0.080	0.092	0.085	0.078
	(0.05)	(0.06)	(0.06)	(0.08)
*MWAGE * ABEV*	-0.304 ***	-0.278 ***	-0.290 ***	-0.259 **
	(0.10)	(0.10)	(0.10)	(0.11)
Regional Fixed Effects	No	Yes	No	Yes

Note: Dependent variable is 3-year historical average annual revenue growth percentage (*RGROWTH),* standard errors in parentheses. *, **, *** indicate significant at the 90%, 95%, and 99% confidence levels, respectively.

[A] OLS is ordinary least squares estimates

[B] 2SLS is two-stage least squares, instrumental variables estimates

Table 5.1. Estimation Results for Annual Revenue Growth Models (N=348), Continued

	OLS[A]		2SLS[B]	
	Model 1	Model 2	Model 3	Model 4
	Market variables			
PDEN	-0.118 *	-0.102	-0.121 *	-0.147
	(0.07)	(0.14)	(0.07)	(0.18)
PGROW	0.287 *	0.412	0.284	0.366
	(0.16)	(0.27)	(0.18)	(0.34)
	Cluster variables			
AGVALUE	1.799 **	1.980 *	1.599	5.302
	(0.89)	(1.14)	(4.27)	(6.43)
DOWNPCNT	0.033	0.051	0.033	-0.006
	(0.04)	(0.04)	(0.08)	(0.12)
FBPCNT	-3.396 ***	-2.822 *	-3.048	-11.338
	(1.28)	(1.45)	(11.00)	(16.60)
*FBPCNT * URBAN*	7.491 **	9.254 *	6.288	11.318
	(3.32)	(4.77)	(5.15)	(7.28)
CONSTANT	10.519	11.269	12.463	20.006
	(13.49)	(20.06)	(17.63)	(23.79)
Regional Fixed Effects	No	Yes	No	Yes
R^2	0.110	0.137	0.088[C]	0.125[C]
AIC	2600.42	2607.36		

Note: Dependent variable is 3-year historical average annual revenue growth percentage (*RGROWTH),* standard errors in parentheses. *, **, *** indicate significant at the 90%, 95%, and 99% confidence levels, respectively.
A: OLS is ordinary least squares estimates
B: 2SLS is two-stage least squares, instrumental variables estimates
C: The R^2 values reported in Models 3 and 4 are the R^2 from the second stage regression of the 2SLS procedure.

Since endogeneity would result in inconsistent estimates from the OLS procedure, but consistent estimates from the 2SLS procedure, one would expect the estimates from OLS and 2SLS to be largely different if there was an issue with endogeneity. Therefore, the similar estimates in our models suggest that there may be limited endogeneity issues in our data. Further support for this was found from formal statistical tests for endogeneity discussed below.

The Hausman specification test can be used to test for endogeneity (Greene, 2003). Endogeneity will cause the OLS estimates to be inconsistent, and the Hausman test will compare the OLS estimates and instrumental variables estimates to test for consistency of the OLS estimates. The null hypothesis is that both the OLS and 2SLS Instrumental Variable (IV) models are consistent. The alternative hypothesis is that only the IV model is consistent. If the null hypothesis is true and both models are consistent, then the estimated coefficients will be similar for both models. However, if the null hypothesis is not true (i.e., the OLS model is inconsistent because of an endogenous variable), the estimated coefficients for the IV and OLS models will differ substantially. The Hausman test thus computes the difference between the coefficients of the two models and tests the magnitude of this difference.

The Hausman augmented regression test as specified in Davidson and MacKinnon (1993, pp 237-239) was performed to test for endogeneity using Models 1 and 3 (i.e., no regional fixed effects). This test resulted in an F-statistic $F(1, 330) = 1.03$ and a p-value of 0.31[1]. Therefore, the test fails to conclude there is evidence of endogeneity. Based on this, there is little evidence to suggest that the 2SLS estimates are superior to the OLS estimates. Further, since the OLS estimates show marginally improved levels of statistical significance, the OLS results (Models 1 and 2) will be used in the post-estimation analysis. Akaike Information Criterion (AIC) scores are also computed for Model 1 and Model 2, the OLS models with and without regional dummies, respectively[2]. AIC is a commonly used measure for model selection which scores the fit of the model and compensates for the number of variables included (see Greene, 2003 p159). Since Model 1 has a slightly lower AIC than Model 2, Model 1

---

[1] The test H_0: x_2 is endogenous in the estimate of $y = X_1\beta_1 + x_2\beta_2 + \varepsilon$, where X_1 is a vector of exogenous variables, a vector Z of instruments (including X_1) is used to estimate $y = X_1\beta_1 + x_2\beta_2 + \ (Z(Z'Z)^{-1}Z'X_1) \propto \ +\gamma$, and α is tested, H_0:α=0 vs. H_A:α≠0. (Hausman, 1978)

[2] For a model with K parameters and n observations, $AIC = \log\left(\frac{e'e}{n}\right) + \frac{2K}{n}$, where $\boldsymbol{e}$ is the vector of residuals (Greene, 2003, p160).

is statistically preferred by this measure, although there is little material difference between the two sets of estimates. Additionally, since *t*-tests find that each regional dummy variable is not statistically different from zero, the inclusion of regional dummy variables in the model does not produce any additional useable interpretations. As such, Model 1, the OLS estimates without regional dummy variables, will be used to produce further interpretations and draw conclusions.

The dependent variable *RGROWTH* is treated as a continuous variable in the OLS model, although in actuality it is an ordered categorical variable with nine defined and relatively narrow categories (See Appendix A). To ensure that this did not bias our results in any substantial way, the empirical model was also estimated as a cumulative logit transformation with five category levels. The empirical results were consistent with the continuous model. However, the continuous model was chosen given its relatively improved statistical performance (i.e., overall significance of parameter estimates).

Due to the spatial nature of the data, a test for spatial autocorrelation was also conducted. An assumption of OLS estimation is that the residuals are independent, and autocorrelation is the presence of correlated residuals. This results in biased standard errors and therefore biased significance testing in OLS (Greene, 2003 p15). With respect to spatially oriented data, the residuals can be correlated based on the relative distance between observations (i.e., spatial autocorrelation).

To test for spatial autocorrelation, Moran's I statistic was calculated for the residuals from Model 1 (Moran, 1950), using the 'proc variogram' procedure in SAS 9.2[3]. The null hypothesis for this test is that residuals are uncorrelated across space

[3] Moran's *I* statistic to test for autocorrelation in variable *X* with mean $\bar{X}$ is defined as $I = \frac{N}{\sum_i \sum_j w_{ij}} \frac{\sum_i \sum_j w_{ij} (X_i - \bar{X})(X_j - \bar{X})}{\sum_i (X_i - \bar{X})^2}$, where *N* is the number of spatial units and w_{ij}. It can be shown that *I* has a normal distribution and thus can be transformed to test the null hypothesis that there is no spatial autocorrelation as H_0:z=0 vs. H_A:z≠0 (Moran, 1950).

(i.e., no spatial autocorrelation) and the alternative hypothesis is that residuals are correlated across space (i.e., spatial autocorrelation). The test results revealed a Moran's statistic z=-1.31, which corresponds to a p-value of 0.19. Thus, we cannot reject the null hypothesis of uncorrelated residuals; i.e., the test does not produce conclusive evidence of spatial autocorrelation.

Firm-Level Variables

The two firm-level variables, age of plant (*YEARS*) and number of employees (*EMPL*), both are associated with statistically significant effects on revenue growth (Table 5.1, Model 1). As expected, younger firms tend to have a higher rate of revenue growth. The growth elasticity with respect to *YEARS* (evaluated at sample means) indicates that a one percent increase in the age of a firm would result in a 0.21% decrease in average annual plant revenue growth (Table 5.2), ceteris paribus. While the result is quite inelastic at the sample mean, changes in revenue growth with age could be relatively large for younger or newly established firms.

Similarly, it was expected that smaller firms would have a higher rate of growth, but the opposite effect was found. Specifically, a one percent increase in employee staffing levels was associated with a 0.44% increase in annual revenue growth (Table 5.2). Typically, smaller firms would be expected to grow at a higher rate since these firms are more likely in a 'growing stage' of their business. However, with respect to firms in this sample, many smaller plants had little intention on increasing employee staffing levels. Specifically, over the next three years, 52% of large plants (over 50 employees) expected to increase employee staffing, compared to only 34% of small plants (one to nine employees) and 17% of non-employer firms (Table 3.3). Expected changes in capital spending revealed the same trends. A smaller percentage of smaller firms were expecting growth in capital spending than medium or large-sized firms (Table 3.2).

Table 5.2. Revenue Growth Elasticities, Calculated at Sample Means (N=348).

Variable	Elasticity
Firm-level variables	
YEARS	-0.209* (0.12)
EMPL	0.445* (0.25)
Labor variables	
HSGRAD	-1.916 (2.74)
MWAGE (*ABEV* = 0)	0.817 (0.53)
MWAGE (*ABEV* = 1)	-2.304** (0.98)
Market variables	
PDEN	-0.121* (0.07)
PGROW	0.072* (0.04)
Cluster variables[A]	
AGVALUE	0.268** (0.09)
DOWNPCNT	0.040 (0.04)
FBPCNT (RURAL)	-0.532*** (0.20)
*FBPCNT*URBAN (URBAN* differential*)*	0.562** (0.25)
FBPCNT (URBAN)	0.308 (0.25)

Note: Elasticities were calculated for Model 1 in Table 5.1, standard errors in parentheses; *, **, *** indicate significance at the 90%, 95%, and 99% confidence levels, respectively.

[A] The within-stream agglomeration elasticities were computed as follows:

$FBPCNT\ (RURAL) = \beta_{FBPCNT} \times (\overline{FBPCNT}|RURAL/\overline{RGROWTH}|RURAL)$

$FBPCNT\ (URBAN$ differential$) = \beta_{FBPCNT*URBAN} \times (\overline{FBPCNT}|URBAN/\overline{RGROWTH}|URBAN)$

$FBPCNT\ (URBAN\ ) = \ (\beta_{FBPCNT} + \beta_{FBPCNT*URBAN})(\overline{FBPCNT}|URBAN/\overline{RGROWTH}|URBAN)$

Alternatively, this result may highlight difficulties faced by smaller firms looking to increase plant size, but may be limited in doing so, given lower growth potential. As such, the result provides some evidence of a need for additional support mechanisms (public or private) to achieve higher growth rates by beginning/small firms to improve current viability and potential for successful expansion in the future.

Industry Fixed Effects

The estimated parameters for industry fixed effects indicate some clear differences in past performance across industry sectors. Given the negative coefficients on all included industry fixed effects, it would appear that 'other' food manufacturers (the excluded category) had the highest average rate of revenue growth, *ceteris paribus* (Table 5.3).

Recall that many processors in the 'other' industry sector grouping included specialty food or niche food product manufactures; however, also included were limited observations from seafood, grain and milling, and non-alcoholic beverage processing firms. While the estimated coefficient for dairy processing was also negative (-1.391), this effect was not significantly different from zero (p-value = 0.521). The same was true for fruit and vegetable processors in the sample (-3.123), although its estimate was marginally significant (p-value=0.116); however, the model with regional fixed effects (Model 2, Table 5.1) did indicate a significant response (marginal effect = -3.635, p-value=0.074).

In contrast, bakeries, meat processors, and sugar/confectionary operations had the lowest growth rates across all industry sectors. Specifically, all else held constant and relative to the base 'other' category, average annual growth rates were 2.866, 3.933, and 5.225 percentage points lower, respectively (Table 5.3).

Table 5.3: Marginal Growth Effects by Industry Sector (N=348).[A]

Variable	Marginal Effect	Predicted RGROWTH
OTHER	--	6.160
	--	
SUGAR	-5.225*	0.935
	(2.71)	
FRTVEG	-3.123	3.036
	(1.98)	
DAIRY	-1.391	4.769
	(2.17)	
MEAT	-3.933**	2.227
	(1.84)	
BKRY	-2.866*	3.294
	(1.74)	
ABEV ($\overline{MWAGE}$)	-0.188	4.703
	(1.73)	
ABEV ($\overline{MWAGE} + 1\ \mathrm{St.Dev.}$)	-4.109**	1.452
	(2.08)	
ABEV ($\overline{MWAGE} - 1\ \mathrm{St.Dev.}$)	3.734*	7.954
	(2.25)	

Note: Marginal effects are from Model 1, Table 5.1. Standard errors in parentheses; *, **, *** indicate significance at the 90%, 95%, and 99% confidence levels, respectively. Predicted industry growth rates were computed holding all other variables constant across industries at overall sample means and URBAN = 0.5.
[A] To account for *ABEV* interaction with *MWAGE*, the marginal effect of *ABEV* is calculated at the mean ($\overline{MWAGE}$) and the mean ± 1 standard deviation ($\overline{MWAGE} \pm 1\ \mathrm{St.Dev.}$).

Since *ABEV* was interacted with *MWAGE*, the level of marginal effect *ABEV* is dependent on the value of *MWAGE*. The mean and standard deviation of *MWAGE* were calculated for the observations from alcoholic beverage processors, and the marginal effect of *ABEV* was then computed at three different values of *MWAGE*: the mean, the mean plus one standard deviation, and the mean minus one standard deviation. For alcoholic beverage processors in counties with average manufacturing wage rates ($47,201 per year), the marginal growth effect (relative to the other food processing industry) was not significantly different from zero, all else constant.

However, firms facing higher wage rates ($60,093 per year) had average growth rates 4.1 percentage points lower than other food processors (Table 5.3). Firms facing the lower wage rates ($34,309 per year) had average growth rates 3.7 percentage points higher than other food manufacturers, *ceteris paribus*. As such, revenue growth performance for this industry is highly dependent on local wage conditions.

Also included in Table 5.3 are average *RGROWTH* estimates predicted by the model, holding all other variables constant across industries (at sample means). In general, the predicted industry marginal effects and growth rates are comparable in most sectors to secondary-data estimates of earlier historical changes from 2001 through 2006 (Figure 5.1). Over this time period, other food, nonalcoholic beverages, and grain processors (in our aggregate 'other' category) all had relatively high changes in output revenues, but less so for seafood (also in our 'other' category). Consistent with our estimates, bakery and sugar industries were clearly the sectors with less growth and, indeed, sugar's growth changes were negative. Thus, our results may be indicative of a longer trend in growth for these sectors in NYS.

The meat sector results for this earlier time period (2001-2006) differ from ours (2006-2008) in terms revenues, where earlier output growth was relatively strong (Figure 5.1). While this sector's performance is highly correlated with commodity livestock prices, our clear difference in growth estimates may indicate other structural changes in the industry between these two time periods. The alcoholic beverage industry output growth estimates are also much lower for this earlier time period, but would be comparable to our 'average wage' estimates in this sector. In deference to the revenue growth changes however, establishment growth was (and continues to be) strong in this sector – the only sector with positive changes in establishment numbers.

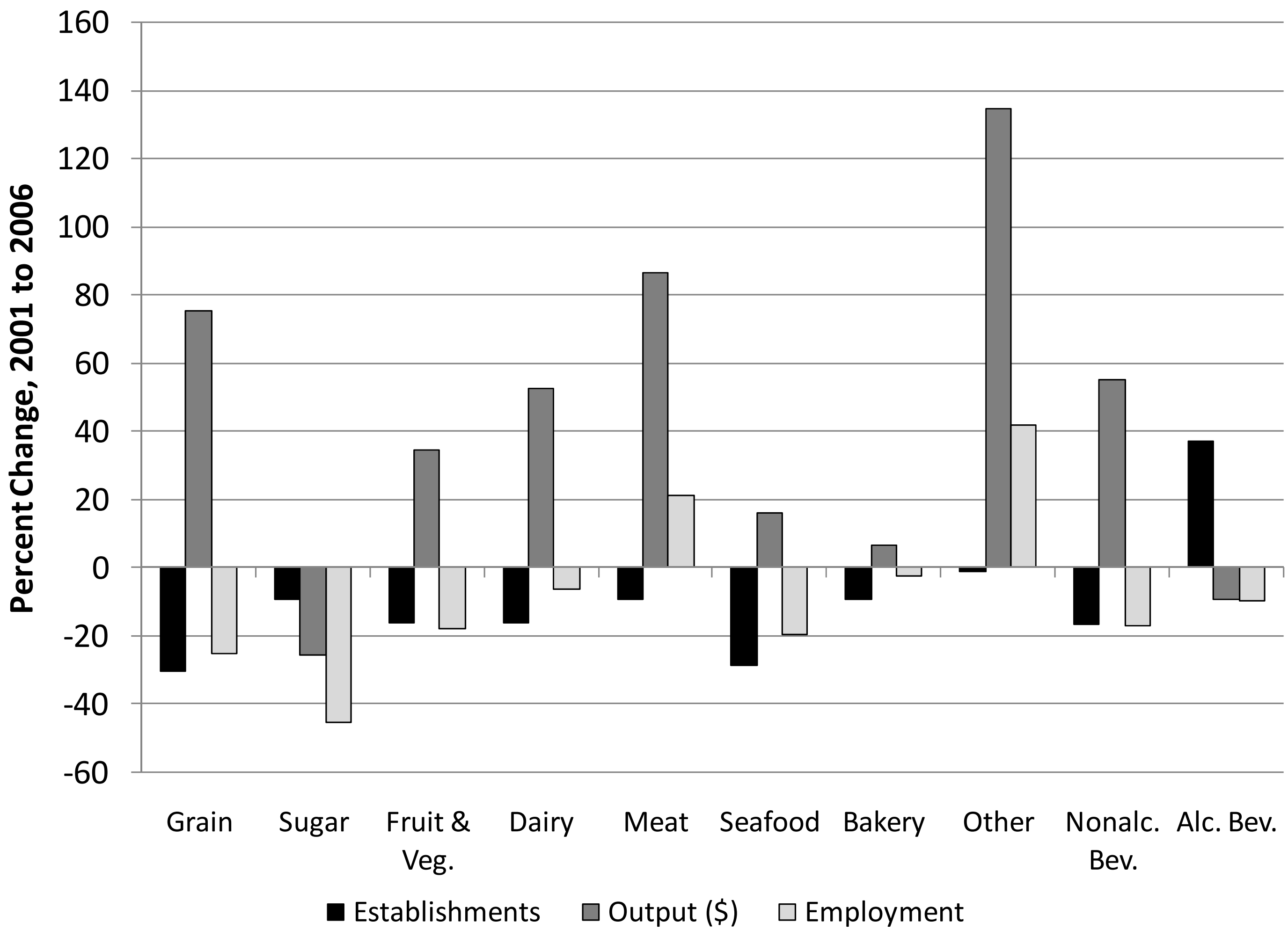

Figure 5.1. Percent Change in Establishments, Output, and Employment by Industry Sector, New York, State, 2001-2006.
Source: U.S. Census Bureau, 2009a; MIG, Inc. 2009

Labor Force

Excluding alcoholic beverage processors, the indicators of labor supply cost and quality (*MWAGE* and *HSGRAD*), did not significantly influence the revenue growth of the firms in our sample. This was likely due, in part, to the majority of respondents employing a relatively small number of employees. As mentioned above, the one sector in which the cost of labor did have a significant effect on revenue growth was with alcoholic beverage processors. Here, a one percent increase in average county manufacturing wages was associated with a 2.3% decrease in revenue growth rate (Table 5.2), a strong and elastic response.

Alcoholic beverage processors in our sample were primarily wineries, with likely relatively high (seasonal) labor costs due to the amount of labor needed for grape harvesting. Other sectors, such as grain milling and milk processing, appear to hire as much or more labor as the wineries in our survey, but these firms are also likely to have large costs from physical capital and utilities that wineries may not have.

Cluster Measures

Within-stream agglomeration effects (as measured by *FBPCNT*) were found to have a significant effect on revenue growth. Specifically, in rural areas, a one percentage point increase in the concentration of food and beverage manufacturers was associated with a decrease in revenue growth by 3.4 percentage points, on average (Table 5.1). While the magnitude of this change is relatively large, a full 1 percentage point increase in *FBPCNT* would represent a sizable change in food processor clustering since the average *FBPCNT* in our sample is relatively low at 0.59%, and ranges from 0.10% to 2.63% (Table 4.1). Alternatively, consider the computed elasticities in Table 5.2. From this perspective, for a one percent increase in *FBPCNT* (i.e., a 1% increase in the concentration of food and beverage manufacturing establishments), annual revenue growth rates would be expected to decrease by 0.53% (Table 5.2).

The interaction term between *FBPCNT* and *URBAN* was also significant and positive, suggesting that agglomeration effects in urban areas were significantly above those in rural areas. However, within urban areas, the effect of changes in the concentration of food and beverage manufacturers (*FBPCNT*) was not statistically different from zero; i.e., the combined industry effect, $\beta_{FBPCNT} + \beta_{FBPCNT*URBAN}$. The estimated elasticity in urban areas was positive (0.31, Table 5.2), but was not significantly different from zero (*p*-value = 0.23).

Firm clustering was expected to have a positive effect on firm performance, as indicated in Henderson and McNamara (2000), Lambert, McNamara, and Beeler (2007), and Asiseh et al (2009); however, these studies used slightly different models and sources of data. Henderson and McNamara (2000) found positive agglomeration effects at the county-level for large food manufacturers only and did not distinguish between urban and rural areas. Recall, our sample is primarily smaller firms. In particular, 42% of rural respondents had less than 5 employees and 89% had less than 50 employees. The distribution of firms by size may therefore influence whether positive localization benefits are seen, although a statistical test failed to find a significant difference in agglomeration benefits by firm size in our sample.

Asiseh et al (2009) found positive agglomeration effects at the state-level and did not examine county-level effects. Lambert, McNamara, and Beeler's (2007) modeling was perhaps closest to ours as county-level data was examined for all food manufacturers and effects were estimated separately for supply-oriented, demand-oriented, and footloose firms in 'metropolitan', 'micropolitan', and 'rural' areas. However, amongst all three categories of firms, agglomeration benefits were positive in rural areas.

Consistent with our approach, however, was Goetz (1997) who found evidence of negative agglomeration effects from firm clustering using county-level data on food manufacturers, although rural and urban differences were not considered. Part of the reason for the negative agglomeration effects in rural areas may be due to the fact that 44% of rural establishments in our sample sold at least 75% of their products directly to consumers (D2C), and it is likely that much of these sales go to consumers living near the plant location. In this way, these firms will face more direct competition from collocated food processors than firms selling primarily to downstream retailers or wholesalers. As such, the results give some evidence that the negative effects from increased competition of food processors located in close proximity to each other in rural areas that rely strongly on D2C sales, may well be greater than other positive effects of firm clustering, such as collaborative activities involving group purchasing or shared distribution.

According to Barkley and Henry (1997), in order for industry clusters to be successful, changes must be made in political, economic, and institutional conditions to discourage competition between firms and encourage collective activities. As such, it is simply not enough for firms to locate close to one another and expect to see benefits from this location. Firms located close to other similar firms must actively try to create collaborative actions with other firms to seek beneficial outcomes and improved firm performance.

In urban areas, the effect of higher concentrations of food and beverage manufacturers was not clear. The results weakly suggest that within-stream firm clustering for urban plants ($\beta_{FBPCNT} + \beta_{FBPCNT*URBAN}$) contributes positively to firm growth, but the effect was not significantly different from zero; albeit statistically greater than the effect of *FBPCNT* for rural plants. This lack of statistical significance may be data driven, due to the sample size of urban manufacturers. Even though 146 plants in our sample were from urban areas (compared to 202 in rural areas), these plants were divided among only 13 counties (43 counties were rural). Since the variable *FBPCNT* varies by county, it is likely that relatively less variation in *FBPCNT* was present across these *URBAN* counties, and reducing the power to find any statistically significant effect.

Additionally, we would expect agglomeration benefits in urban areas to accrue through urbanization economies as well as possible localization economies. If so, we would thus expect to see evidence of urbanization economies through the inclusion of population-based variables (e.g., *PDEN* and *PGROWTH*), rather than through the firm clustering (localization) variable. Localization economies may still arise in urban areas. For example, food processors may concentrate in a small neighborhood of a large metropolitan city and benefit from the cooperative activities this close location provides, or certain districts of a city may provide access to unique infrastructure (e.g., areas surrounding a port or rail terminal). However, our county-level measures are not detailed enough to pick up these effects. Data at a unit smaller than the county would be needed to effectively pick up localization economies within metropolitan areas.

In addition to agglomeration effects from within-stream clusters, we expected firm growth to be strongly influenced by market access, specifically through upstream and downstream clusters, or concentrations of potential input suppliers and downstream buyers. As expected for agricultural-based manufacturing, the upstream clustering variable (*AGVALUE*) was shown to have a statistically significant positive effect on revenue growth. Specifically an increase in *AGVALUE* (county crop and livestock production receipts per capita) by one percent was associated with an increase in average revenue growth by 0.268% (Table 5.2). While inelastic, the level is sizable relative to negative effects from within-stream firm clustering in rural areas (-0.532, Table 5.2). This result is also consistent with other studies (Goetz, 1997;

Henderson and McNamara, 2000) and suggests that access to agricultural raw inputs is strongly beneficial to the food and beverage processors in our sample.

The results from the Principal Components Analysis of the business environment ratings in our survey further supports that access to markets is a primary concern for many firms. Market access variables, including proximity to input supplies, were among the business environment factors rated as most beneficial (see Chapter 3). Goetz (1997) commented that measures of county agricultural production may also be an indicator of rurality and the associated qualities of rural areas such as availability of land. Most likely, some of our sample from rural areas benefit from close access to agricultural inputs such as milk processors and grain millers, while other types of firms in may benefit from other aspects of rural areas (e.g., wineries).

Just as upstream market access benefitted surveyed firms, it was expected that access to downstream markets would be beneficial to firm growth as well. However, downstream firm clustering, as measured by the number of foodservice and food and beverage wholesale and retail operations per capita (*DOWNPCNT*) did not have a significant effect on revenue growth. This was somewhat surprising given past studies' findings of the importance of downstream markets, although none of these studies used the concentration of downstream firms as a measure.

From the Principal Components Analysis, downstream market factors such as proximity of customer markets were also rated highly beneficial to growth by firms. The insignificance may be a result of the makeup of our sample, wherein much of the sales are D2C. The benefits of locating near a cluster of foodservice and food and beverage wholesale and retail firms may only accrue to a small percentage of our sample that access and utilize these sales channels. Given the distribution of sales through alternative outlets in our sample, downstream effects may more effectively be captured through population-based variables.

Previous studies have stressed the importance of access to product markets and have found evidence of beneficial effects to firms by locating near urban areas, and notably attributed to output market access provided by large populations in urban areas (Lambert, McNamara, and Beeler, 2007; Davis and Schluter, 2005; Henderson and McNamara, 2000). Lambert, McNamara, and Beeler (2007) conclude that food processors tend to select locations in or around urban areas, or in rural areas that provide access to product or input markets, such as through transportation infrastructure or areas that provide agglomeration economies.

As such, even though downstream effects were not found to be statistically significant with the *DOWNPCNT* variable, we might expect to find downstream effects reflected in the population variables *PDEN* and *PGROWTH* included. Somewhat surprising, population density (*PDEN*) was shown to have a significant, slightly negative effect on revenue growth. Specifically, a one percent increase in *PDEN* decreased revenue growth by 0.121% (Table 5.2). This may be due, in part, to more limited infrastructural or operational capacities in more highly residential areas, but if food processors preferred locating near urban areas, as previous studies have suggested, this effect should be positive. Goetz (1997) and Lambert, McNamara, and Beeler (2007) found large local populations (not population densities) increased the growth of the food manufacturing industry.

Another variable was also used to describe downstream effects, and that was the rate of population growth, *PGROWTH*. Although no previous studies included this measure, we expect that growth in local populations (rather than just the size of the population itself) would be important to the growth in food manufacturing output. This indeed was found to be true. Specifically, a one percent increase in population growth rates increased annual revenue growth rates by 0.072% (Table 5.2). Alternatively, a one percentage point increase in population growth increased annual revenue growth by 0.287 percentage points. This provides empirical evidence of the importance of customer growth in improving firm performance.

Another possibility for why we see mixed results with respect to firms locating near urban areas is that urban areas, in general, tend to have the highest rates of population growth. In New York State, the highest rates of population growth recently were in the Mid-Hudson, Long Island, Capital, and New York City regions, all areas close to New York City. As such, if county population growth rates were not controlled for in our estimates, we would expect to see signs of revenue growth in these urban and urban-fringe areas with high population growth rates. When county population growth rates are controlled for we actually see slightly negative effects on growth from urbanization (as proxied for by *PDEN*), and a positive effect from population growth. Previous studies (Lambert, McNamara, and Beeler, 2007; Davis and Schluter, 2005) have seen increasing numbers of firms locating near urban areas. Our results suggest that these urban effects may be the result of population shifts rather than any other particular qualities of urban areas.

Maple Model

As discussed in chapter 4, a separate model was estimated describing annual revenue growth for maple producers (Table 5.4). In general, parameter estimates had less statistical significance than the estimates in Table 5.1, however the level of explained variation was similar ($R^2 = 0.11$). Given that many of these firms may not be necessarily profit maximizing firms (i.e., hobby, or part-time businesses), this result was not unexpected.

Table 5.6. OLS Estimates of Maple-Only Model (N=71)

Variable	Model 1	Model 2
Firm-level variables		
YEARS	0.014	-0.007
	(0.06)	(0.06)
EMPL	0.181	-0.038
	(2.37)	(2.39)
SALESUS	0.033	0.037
	(0.05)	(0.06)
Cluster variables		
FBPCNT	-0.316	-0.939
	(2.63)	(3.25)
AGVALUE	-0.577	-1.124
	(1.05)	(1.49)
DOWNPCNT2	-1.786	-2.863*
	(1.44)	(1.63)
Population variables		
PDEN	24.063**	21.185*
	(10.22)	(12.18)
PGROW	0.425	0.227
	(0.62)	(0.74)
INCOME	-1.470*	-1.625*
	(0.75)	(0.84)
CONSTANT	73.392*	93.161
	(36.84)	(40.95)
Regional Fixed Effects	No	Yes
R-Squared	0.114	0.200
AIC	534.959	537.658

Note: Dependent variable is 3-year historical average annual revenue growth percentage (*RGROWTH),* standard errors in parentheses. *, **, *** indicate significant at the 90%, 95%, and 99% confidence levels, respectively.

t-tests indicate that *PDEN* and *INCOME* were the only variables with coefficients statistically different from zero at a 90% confidence level or above in Model 1, without regions (Table 5.4). When regions were added the downstream firm cluster variable, *DOWNPCNT2,* was also significant. The large positive effect of *PDEN* on *RGROWTH* is consistent with the hypothesis that a larger local output market will increase growth for this type of firms. Specifically, a one percent increase in *PDEN* results in a 0.86% increase in *RGROWTH*[4]. The maple processors in our sample sold the highest proportion of their production D2C, so it would be expected that a larger local population would be beneficial to these plants.

The downstream clustering variable, *DOWNPCNT2,* had a statistically significant and negative effect on plant growth only when regional fixed effects were included (Model 2, Table 5.4). Again, since maple processors in our sample sell primarily to consumers, rather than retail or wholesale, it is not surprising that downstream firm clusters do not have a positive effect on the growth of maple plants, and, in fact, they appear to have a very strong negative competition effect, perhaps by including similar maple products produced outside the local (county) area. Specifically, a one percent increase in workers employed in downstream food and beverage establishments leads to a 7.0 percent decrease in revenue growth.

The within-stream firm clustering variable *FBPCNT* does not have a significant effect on the growth of maple plants. Possibly, maple plants may have little interaction with other types of more traditional food and beverage processors, and thus would neither experience positive nor negative effects from a local concentration of these firms.

Finally, a one percent increase in average incomes (*INCOME*) resulted in a 10.9% decrease in *RGROWTH* in Model 1. The income measure represents average

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[4] Elasticities were calculated at the sample means.

county wages per worker, and may be indicative of a strong, negative income effect; households with higher incomes may purchase less maple products. Alternatively, this measure may also be indicative of cost of living and, more specifically, the cost of land. Areas with wealthy populations may be highly desirable places to live and thus the price of land may be high. When land becomes more valuable, maple processors would find it more profitable to use the land for other purposes than maple production.

CHAPTER 6

CONCLUSION

The viability of the manufacturing sector in New York State (NYS) relative to other areas of the U.S. is of growing concern, and policy makers and development agencies are increasingly looking towards agriculturally-based manufacturing opportunities to better take advantage of the large and diverse agricultural production sectors in the state. This study's focus was on determining the primary factors affecting firm growth for food and beverage manufacturing operations operating in NYS, with particular attention focused on firm agglomeration (or clustering) and market access effects. The results of this research should contribute importantly to more-informed firm management, industry association, and public policy decisions aimed at improving firm viability and sector performance.

In deference to previous studies that used more aggregate data, a firm-level survey was conducted in NYS so as to more accurately evaluate firm-level effects under current market environments. In addition, primarily due to data availability, much of the previous research has focused on larger processing operations. The survey of firms used here contains a high number of small to medium-sized firms, and is thus more representative of the population and distribution of firms operating within the state.

Implications of Results

Average firm growth across industry sectors was highly heterogeneous, but recent growth rates were highest in more non-traditional sectors that included specialty, niche, or alternative food product manufacturers. Dairy product and fruit and vegetable processors' growth rates were roughly on par or slightly lower than these other food manufacturers. If targeted industry efforts are to be considered, bakery operations, meat processing, and sugar/confectionary product firms had significantly lower growth rates, on average.

As expected, younger firms had higher annual revenue growth rates than larger, more established firms. Younger firms are often in a growing-stage of their business, where initial start-ups are at a level less than their ideal size. However, this result has additional implications. Anecdotal evidence from firm focus groups conducted in the state following this survey indicated that little incentives exist for established, older firms to maintain the size of their operations, relative to policy programs aimed at new start-ups or expansions of firms to create *new jobs* (a politically savvy metric). Lower growth rates estimated here may be a consequence of such policies (or lack thereof). While arguably more complicated, additional policies (perhaps focused on employee seniority incentives) or collaborative firm operational arrangements should be considered when more moderated growth for established firms is insufficient for long-term viability. In addition, older firms are likely to be already utilizing beneficial opportunities such as firm collaborations, so new opportunities may need to be created such as policies addressing improved efficiencies in accessing upstream and downstream markets.

Unexpectedly, larger firms (in terms of employment) were estimated to have higher rates of revenue growth, consistent with other survey results that indicated a much lower proportion of smaller firms were expecting to increase employee staffing or capital spending in the future. This result may be highlighting difficulties faced by smaller firms looking to increase plant size, but may be limited in doing so due to capital constraints or more limited access to larger downstream markets due insufficient product volumes for buyers. As such, the result provides some evidence of a need for additional support mechanisms (public or private) to achieve higher growth rates by beginning/small firms that improve current viability and the potential for successful expansion in the future.

In general, the growth analysis found, similar to previous studies, that market access effects are amongst the most dominant determinants in the growth of food and beverage manufacturing firms. Increased access to raw agricultural inputs and growing population centers were important upstream and downstream market conditions to improving firm growth and viability. Importantly to a strong agricultural state like New York, strong agricultural production sectors thereby reinforce stronger downstream agriculturally-based manufacturing enterprises.

In addition, within-industry firm clustering effects varied significantly between rural and urban areas. In rural areas, increased food and beverage manufacturing firm concentration reduced average revenue growth rates for firms in comparison to their urban counterparts, presumably from higher competition effects with local firms primarily serving local markets. With growing interest in developing local and regional food systems within smaller, rural communities, community planners and plant executives need to be aware of competition issues and consider the development of public policy or operational procedures reinforcing holistic community food-systems planning and the availability of collaborative firm activities that can offset potential negative competition effects.

While within-stream firm clustering in rural areas was shown to have a negative effect on firm growth, results from a Principal Components Analysis on business environment factors showed that cooperative activities such as regional branding and the availability of alliances with other firms were very beneficial. A large percentage of firms reported involvement in some type of collaborative activity, where approximately 53% of rural respondents reported involvement in at least one type of collaborative activity with other firms.

Perhaps this is the result of the mechanisms through which agglomeration benefits tend to accrue in the food and beverage manufacturing industry as opposed to others. The agglomeration benefits in some industries require a dense location of firms. Firms in a technology cluster need to be located in the same area so that the specialized labor pool can be shared. Firms doing government contract work require human interaction with government agencies and therefore benefit from locating near government offices. However, for the food and beverage manufacturing industry, external economies of scale can be often created through cooperation between firms located in opposite corners of the state, just as easily as firms at opposite sides of the street.

The follow-up focus groups provided anecdotal evidence of the ways in which these firms have benefitted from collaborations with other firms. Some of these examples include purchasing inputs with other similar firms to negotiate lower prices and using group distribution and sales channels such as dairy cooperatives or shared space in farmers' markets. Anecdotal evidence suggests that especially beneficial to food and beverage manufacturers are state industry associations. Amongst NYS food and beverage manufacturers, wine producers, maple producers, meat processors, and dairy processors all have state-wide industry associations. These associations are able to provide marketing and branding for their members, lobby at the state level for favorable public policies, and share knowledge and operational information to their members.

These state-wide trade associations could also explain why Goetz (1997) found positive agglomeration effects at the state-level but negative agglomeration effects at the county-level. A large concentration of food manufacturers at the state-level could provide large benefits to those firms through well-funded state trade associations, while a large concentration of firms in a single county would not benefit those firms in the same way. For example, states with especially concentrated food and beverage manufacturing sub-industries may be able to promote the state's product and brands successfully across the country (e.g., Florida orange juice, California wine, Welch's (NY) grape juice).

With the advancement of technology, it should be easier now than ever before for firms to collaborate at longer distances from one another. A decade or two ago, before internet services were widely available, perhaps the close physical location of clusters would be more important to foster cooperation in the food manufacturing industry. Today, it should be easier for collaborative groups to share information and recruit new members through modern communication channels.

Based on these conclusions, policies which promote intra-industry or cross-industry collaboration would likely benefit food and beverage manufacturers, but these policies would not necessarily require geographic proximity between firms. Moreover, in rural areas especially, planners need to be aware of possible negative effects from growing concentrations of these firms (i.e., negative competition effects, lack of adequate infrastructure), so that these issues can be addressed before they slow local business growth. Additionally, support for programs to encourage collaboration between firms at the state level, such as state-wide trade associations, may be highly effective.

The growth modeling suggests that access to raw agricultural inputs improves the performance of firms. The Principal Components Analysis of business environment factor ratings suggests that market access, both input and output market access is important to operations of these firms. Based on these conclusions, policy options that improve efficiencies of market access should improve the growth of the food and beverage manufacturing industry within NYS. This might include investments in transportation infrastructure such as highways. Also, New York City is the largest source of potential consumption in the region and upstate New York food manufacturers may not be accessing this market as much as they could be (on average, only 9.2% of upstate production in the sample was sold to downstate buyers). Additional programs that bring upstate New York food and beverage manufacturers to New York City markets or connect New York City restaurants with upstate processors may be one source of potential growth.

As access to raw agricultural inputs appears to be highly beneficial to NYS food and beverage manufacturers, policies or collaborative firm activities (e.g., group purchasing or shared distribution or transportation capabilities) that address these upstream markets may also be beneficial. Programs which provide better communication and collaboration between food and beverage processors and agricultural producers may provide an additional source of growth.

Directions for Future Research

The results from this analysis contribute new information to the current understanding of the food manufacturing industry, and additionally raise some new questions to be addressed in the future. Our conclusions further support the contention that market access is one of the most influential location factors on the performance of food manufacturers, just as previous studies have found, yet firm growth near large population centers is explained more by growth in population than by the absolute size of the population itself. More analysis of these population effects is needed to better understand and differentiate dynamic population effects.

Additionally, we failed to find significant agglomeration economies from the presence of retail, wholesale, and foodservice firms, yet the market access created by close location to these firms is likely to be beneficial to food manufacturers in general. The pathways through which food manufacturing firms create market access are somewhat ambiguous in previous research. Our study provides some analysis of sales channels (i.e., consumer, foodservice, retail, wholesale, etc.), and further study of these routes and supply chains to markets is needed in order to understand how to increase market access to benefit manufacturers.

It remains somewhat unclear as to the source of agglomeration benefits accrued to food manufacturers in close location to one another. While our analysis finds a negative effect on firm growth in rural areas, past research has found positive effects, and different effects have been found by size and industry sectors within food manufacturing. We present some evidence of collaborative activities, but the actual manner in which close proximity between firms creates beneficial collaborations has not been fully investigated. Further research is needed to better understand the dynamics of urbanization and localization agglomeration economies for food manufacturing firms that are likely to be highly dependent on the distributional choices made by firms to alternative market channels.

APPENDIX A

Assessing the Future of Food and Beverage Manufacturing in New York State

A survey of food and beverage manufacturers and processors

If you prefer, an online version of the survey may be found at:
http://agribusiness.aem.cornell.edu/foodmanuf.html

Purpose: To identify and address business challenges and opportunities for food and beverage manufacturing firms in New York State. We are committed to working with you and with agencies around the State to discover solutions to enhance the success of the industry.

Directions: Please answer the survey questions as they relate to your **specific plant only**. All responses will remain confidential. Results will be reported in aggregate form only.

Please return by March 2, 2009

If you have any questions, contact:

Kristen Park, Cornell University, 116 Warren Hall, Ithaca, NY 14853; (607) 255-7215 or ksp3@cornell.edu.

I. Business Characteristics

In this section we are interested in learning about your plant's activities in New York State.

1. Does your plant manufacture or process food, beverages, or food ingredients in New York State? *(check one)*
   - ❑ Yes
   - ❑ No (You do not need to complete this survey, but please return to us. Thank you!)
2. Which industry category below best describes your plant's PRIMARY food manufacturing activity? *(check ONLY ONE)*
   - ❑ **Grain and Oilseed Milling** – includes flour, malt, rice, starch and vegetable fats and oils, wet corn, soybean and other oilseed, & breakfast cereals
   - ❑ **Sugar and Confectionery Product Manufacturing** – includes sugarcane and beet sugar, chocolates & non-chocolate confectioneries
   - ❑ **Fruit and Vegetable Preserving and Specialty Food Manufacturing** – includes fruit and vegetable juices, freezing, canning, pickling, drying, dried & dehydration products
   - ❑ **Dairy Product Manufacturing** – includes fluid milk, creamery butter, cheese, dry condensed, evaporated, & frozen desserts
   - ❑ **Animal Slaughtering and Processing** – includes animal slaughter & meat further processing
   - ❑ **Seafood Product Preparation and Packaging** – includes preparation, packaging, canning, freezing
   - ❑ **Bakeries and Tortilla Manufacturing** – includes retail and commercial bakeries, bread, frozen cakes, pies, pastries, cookie, cracker, pasta, flour mixes and dough, & tortillas
   - ❑ **Other Food Manufacturing** – includes snack food, roasted nuts, peanut butter, coffee and tea, flavorings, seasonings and dressings, & other perishable prepared food
   - ❑ **Non-alcoholic Beverage Manufacturing** – includes soft drinks, bottled water, and ice.
   - ❑ **Alcoholic Beverage Manufacturing** – includes breweries, wineries, & distilleries

   If you could not find an example of your primary activity, please briefly describe it:

   ____

3. How long has your plant been doing business in NYS? __________ years

4. Does your plant belong to a company that operates other plants?

   ❑ Yes   If Yes, where? *(check all applicable locations)*

   ❑ *in New York State*   ❑ *elsewhere in the US*   ❑ *in other countries*

   ❑ *No*

5. Where are your company's headquarters located? *(check one)*

   ❑ at this site   ❑ elsewhere in NYS   ❑ elsewhere in the US   ❑ in another country

6. What were your plant's gross revenues in your most recent fiscal year? *(check one)*

   ❑ <$1 million   ❑ $51 - $100 million   ❑ $301 – 500 million
   ❑ $1 - $10 million   ❑ $101 - $300 million   ❑ over $500 m million
   ❑ $11 – $50 million

7. What is the **average** number of full- and part-time employees, including contract and seasonal workers, currently working at your plant? *(check one)*

   ❑ 0 employees   ❑ 10 – 19   ❑ 100 – 249
   ❑ 1 – 4   ❑ 20 – 49   ❑ 250 – 499
   ❑ 5 – 9   ❑ 50 – 99   ❑ 500 or over

8. Approximately what percent of your sales in the last fiscal year were to each customer type? *(Please use 0% if you did not sell directly to a particular customer type)*

Customer Type	Percent of Sales
Wholesalers/Distributors	
Retailers	
Foodservice (restaurants, fast food, schools, etc)	
Individual consumers	
Other food processors or manufacturers	
Other, please describe: ______________________	
Total Plant Sales	100%

9. To better understand the movement of product within and outside of the State, approximately what percent of your raw product input costs AND what percent of your sales in the last fiscal year were from and delivered to the following areas?

	Percent of Raw Product Input Costs	Percent of Sales
Downstate New York*		
Upstate New York (all other)		
Elsewhere in the US		
Outside the US		
Total	100%	100%

*Downstate NY includes Rockland, Putnam, and Westchester Counties, the NYC Burroughs, and Long Island

10. Does your plant process or manufacture any organic products?

❑ Yes ❑ No

If Yes, do you see this segment of your business:

❑ decreasing ❑ staying the same ❑ increasing ❑ don't know

II. Your Business Environment

11. In this section, we are interested in learning about how each of the following factors affects your business. Please rate the current performance level for each factor in New York State.

NYS business environment factors	Very harmful to your business	Harmful to your business	Neither harmful nor beneficial to your business	Beneficial to your business	Very beneficial to your business	Not Applicable
			check one in each row			
a. Quality of transportation infrastructure (roads, airports, rail, ports)	❑	❑	❑	❑	❑	❑
b. Quality of communication infrastructure (telephone, cell coverage, wireless, broad band)	❑	❑	❑	❑	❑	❑
c. Level of State initiatives & growth incentives to support business growth	❑	❑	❑	❑	❑	❑
d. State support for improved environmental practices	❑	❑	❑	❑	❑	❑
e. State support for energy efficiency and renewables	❑	❑	❑	❑	❑	❑
f. Ability to enter into Public-Private sector partnerships	❑	❑	❑	❑	❑	❑
g. State-level costs of doing business (workers' compensation, NYS taxes)	❑	❑	❑	❑	❑	❑
h. Other costs of doing business (real estate, utilities)	❑	❑	❑	❑	❑	❑
i. State- and local-level governmental regulations and permitting procedures (environmental, zoning, health)	❑	❑	❑	❑	❑	❑
j. The cost of living for your employees	❑	❑	❑	❑	❑	❑
k. Your region's overall quality of life (climate, cultural, and recreational opportunities)	❑	❑	❑	❑	❑	❑
l. Quality of State college and university research, outreach, and technical assistance	❑	❑	❑	❑	❑	❑
m. Availability of workers with the skills your business requires	❑	❑	❑	❑	❑	❑

NYS business environment factors	Very harmful to your business	Harmful to your business	Neither harmful nor beneficial to your business	Beneficial to your business	Very beneficial to your business	Not Applicable
n. Availability of management and other professional staff with the qualifications your business requires	❑	❑	❑	❑	❑	❑
o. Labor force wage rates	❑	❑	❑	❑	❑	❑
p. Availability of workforce training opportunities	❑	❑	❑	❑	❑	❑
q. State branding, promotional and marketing campaigns (Pride of New York)	❑	❑	❑	❑	❑	❑
r. Regional or local branding activities and efforts	❑	❑	❑	❑	❑	❑
s. Availability of alliances and collaborations with other firms	❑	❑	❑	❑	❑	❑
t. Availability of trucking services (short & long haul)	❑	❑	❑	❑	❑	❑
u. Availability of product distribution services	❑	❑	❑	❑	❑	❑
v. Proximity to customer markets	❑	❑	❑	❑	❑	❑
w. Proximity of input suppliers	❑	❑	❑	❑	❑	❑

12. What do you feel are the most effective programs or initiatives in New York State that improve the competitiveness of your business? *Please list the top 2.*

a. ______________________________
b. ______________________________

13. Please rate how the following consumer trends affect your business.

Consumer Trends	Very harmful to your business	Harmful to your business	Neither harmful nor beneficial to your business	Beneficial to your business	Very beneficial to your business	Not Applicable
a. Increased demand for locally produced food	❑	❑	❑	❑	❑	❑
b. Increased demand for safe, nutritious, and quality food	❑	❑	❑	❑	❑	❑
c. Increasing interest in sustainability issues	❑	❑	❑	❑	❑	❑

14. Below are some alliances or collaborations sometimes used strategically by businesses. Please check whether or not you currently participate in any collaborative venture in these areas **AND** rate how *valuable* each venture may be in relation to your own business. **Please rate each collaboration even if you currently do not participate in it.**

Currently participate *(check all that apply)*	Collaborative Effort	Not at all valuable	Somewhat valuable	Valuable	Extremely valuable
❑	Group purchasing	❑	❑	❑	❑
❑	Shared services	❑	❑	❑	❑
❑	Marketing & promotion	❑	❑	❑	❑
❑	Legislative affairs	❑	❑	❑	❑
❑	Workforce development	❑	❑	❑	❑
❑	Distribution/transportation	❑	❑	❑	❑

III. Economic Vitality

Please fill out the following information surrounding your past and expected outlook in business operations for your plant as it operates in New York State.

15. Please estimate your plant's *average* annual revenue growth over the past 3 years **AND** for the next 1 and 3 years: *(place a check in the appropriate box in each column)*

	Annual revenue growth for PAST 3 YEARS	Expected annual revenue growth for NEXT 1 YEAR	Expected annual revenue growth for NEXT 3 YEARS
over -20%	❑	❑	❑
-11 to -20%	❑	❑	❑
-5 to -10%	❑	❑	❑
-1 to -4%	❑	❑	❑
0%	❑	❑	❑
1 to 4%	❑	❑	❑
5 to 10%	❑	❑	❑
11 to 20%	❑	❑	❑
over 20%	❑	❑	❑

16. Outlook for employee staffing	Next 1 Year	Next 3 Years
a) We will be hiring additional employees	❑	❑
b) Staying at about the same level of employees	❑	❑
c) We will be reducing our workforce	❑	❑
d) Not sure	❑	❑

17. Outlook for capital spending relative to current year

	Next 1 Year	Next 3 Years
a) Increased spending	❑	❑
b) Level spending	❑	❑
c) Decreased spending	❑	❑
d) Not sure	❑	❑

18. New York State is a great place for our plant to do business *(please check the most appropriate one)*

- ❑ Strongly agree
- ❑ Agree
- ❑ Neither agree nor disagree
- ❑ Disagree
- ❑ Strongly disagree

19. We are currently considering moving our plant out of New York State: *(please check the most appropriate one)*

- ❑ Aggressively
- ❑ Moderately
- ❑ Somewhat
- ❑ Not at all

(The end)

Thank you for your time!

Please mail us your completed survey in the envelope provided.

You may also fax the survey to: (607) 255-4776

We will be compiling the information quickly and holding several focus groups across the State to discuss and extend the results. Please let us know if you would be interested in participating in a regional focus group, and we can send details as they develop. Also, please leave your contact information so we can to send you a report of the survey results.

❑ I am interested in learning more about the focus groups you will be holding across the State.

Name ________________________________

Company and Title________________________________

Address ________________________________

Email ________________________________

Phone ________________________________

APPENDIX B

Cornell University

Todd M. Schmit, Assistant Professor
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Department of Applied Economics & Management
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February 16, 2009

Dear Plant Management:

Your firm has been identified as having food or beverage manufacturing operations in New York State and is being invited to participate in an important study being conducted by faculty in the Department of Applied Economics and Management at Cornell University. The focus of this project is to assess the future of food and beverage manufacturing in the state and is expected to generate a number of benefits for the industry, including:

- Estimating the current level of economic contributions the industry makes to the New York State economy;
- Identifying current opportunities for business retention and growth, potential strategies to improve firm competitiveness, and market barriers hindering firm performance; and
- Offering policy makers and business managers valuable information that will enhance the business climate in New York State and the future success of the industry.

To realize these benefits **we need your help**. Enclosed you will find a survey directed towards food and beverage manufacturing plants in the State that will provide us with valuable information needed to conduct this study. The survey was developed with the support of a talented group of industry and agency representatives that have been advising us on this project. Please have someone (or a group) at your plant best qualified complete the survey and return it to us. All individual plant data and information will be kept confidential and reported only in aggregate form.

Those plants responding to the survey will receive a final project report based on input from all participating plants, as well as additional information and recommendations this project will develop. In addition, all respondents are invited to participate in regional focus groups as a follow up to the survey and giving us an additional opportunity to receive critical feedback. As an additional incentive, those replying will be included in a drawing to win one of 10 Cornell gift baskets featuring a collection of food and beverage products manufactured right here on campus.

If you have any questions about the research project or survey, don't hesitate to contact myself or Kris Park, our survey coordinator, at 607.255.7215 or ksp3@cornell.edu. In order for us to move forward in a timely manner, please return your completed survey by **March 1, 2009**, either by completing the enclosed survey and returning it in the pre-addressed, postage paid envelope or by completing the online version of the survey located on our project website **http://agribusiness.aem.cornell.edu/foodmanuf.html**.

Thanks in advance for taking the time to complete the survey. Your assistance is valued and will provide data essential to the success of this project.

Sincerely,

Todd M Schmit

Todd M. Schmit, Project Director

Encl: Plant survey

APPENDIX C

Cornell University

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March 9, 2009

Dear NYS Food and Beverage Manufacturer:

Two weeks ago we sent you an important survey aimed at evaluating the current state and future outlook for food and beverage processing in New York State. This survey was sent to manufacturers spanning a wide range of products and types of processing operations. The list included "standard" manufacturers, such as dairy, meats, grains, and fruit and vegetable processors, as well as wineries, maple syrup processors, specialty foods manufacturers, and soft drink bottling plants. This is part of an important study to help improve the competitiveness of your firm and to identify strategic industry opportunities moving forward.

To do this **we need your help**. If you've misplaced your original survey, a hard copy can be downloaded from our website **http://agribusiness.aem.cornell.edu/foodmanuf.html**. You are also welcome to complete the **survey online** by following instructions on the website.

The survey was developed with the support of an impressive Advisory Council. Members include:

- Constellation Brands
- Agri-Mark Cooperative
- Dr. Pepper Snapple Group
- Allens, Inc.
- Star of the West Milling Co.
- NYS Dept. of Ag & Markets
- NY Wine & Grape Foundation
- Upstate Niagara Cooperative
- Clinton's Ditch Cooperative
- Wilson Beef Farms
- Merle Maple Farm
- Empire State Development
- Frito Lay
- Steuben Foods
- National Grape & Welch's
- NY Seafood Council
- NY Farm Bureau
- Cornell Ag & Food Technology Park

Please have someone (or a group) complete the survey and return it to us by **March 16, 2009**. All individual plant data and information will be kept confidential and reported only in aggregate form. Also note that the survey is plant-specific; i.e., businesses with multiple plants in the state are asked to complete one survey for each plant.

Survey respondents will receive a final project report and are invited to participate in regional focus groups this summer to give us an opportunity to receive critical feedback. As an additional incentive, those replying will be included in a drawing to win one of 10 Cornell gift baskets featuring a collection of food and beverage products manufactured right here on campus.

If you have any questions about the research project or survey, don't hesitate to contact myself or Kris Park,

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